THE HEALTH OF THE STATE

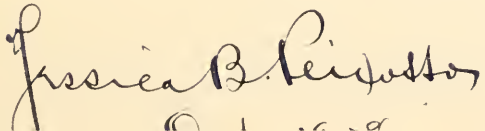
BY

GEORGE NEWMAN, M.D.

SOCIAL SERVICE SERIES No. 2

EDITED BY PERCY ALDEN, M.P.

THE HEALTH OF THE STATE.



SOCIAL SERVICE HANDBOOKS

No. 2.

THE HEALTH OF THE STATE

BY

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SECOND EDITION

London:

HEADLEY BROTHERS

BISHOPSGATE STREET WITHOUT, E.C.

FIRST EDITION, MAY, 1907.

SECOND EDITION, OCTOBER, 1907.

PREFATORY NOTE.

THIS little book has been written in response to the request of my friend, Mr. Percy Alden. It is of an introductory character only. It is not intended to be a text-book, but an elementary handbook dealing in plain language with some of the more important problems of public health. It is addressed to laymen, and, as its title indicates, to those citizens in particular who desire to render of their free will some social service to the State. Personal service is still the great factor in human affairs.

In the study and practice of preventive medicine, few things have impressed me more than the fact that substantial progress is possible only on the basis of a hearty and sane co-operation, a partnership as Edmund Burke called it, between those who govern and those who are governed. The health of the people is no doubt, in theory, the supreme law, but to make it a practice it is certain that the will of the people is the supreme method. And its will should be controlled and guided by a knowledge of things as they are. Progress seems, therefore, to depend upon a wide dissemination of some of the

more important findings in this department of science. It has been said that "the people perish for lack of knowledge," which, if it be so, is a pathetic situation indeed. It may be also that this lack of knowledge leads to lack of desire and will to exercise the considerable powers they possess for the proper control of the health of communities. Yet there is no department of government in the State where co-operation is so necessary, and at the present time so needed, as in the maintenance of a higher standard of public hygiene.

This little volume may, therefore, be looked upon in some sort, as a missionary handbook, sent forth as a reminder that the physical health and fitness of the people is the primary asset of the British Empire, and the necessary basis of that social and moral reform which has for its end "the creation of a higher type of man."

GEORGE NEWMAN.

London,
October, 1907.

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SINCE the essence of wealth consists in power over men, will it not follow that the nobler and the more in number the persons are over whom it has power, the greater the wealth ? Perhaps it may even appear, after some consideration that the persons themselves *are* the wealth. . . In fact, it may be discovered that the true veins of wealth are purple—and not in Rock, but in Flesh—perhaps even that the final outcome and consummation of all wealth is in the producing as many as possible full-breathed, bright-eyed, and happy human creatures. . . . I can even imagine that England may cast all thoughts of possessive wealth back to the barbaric nations among whom they first arose; and that she, as a Christian mother, may at last attain to the virtues and the treasures of a Heathen one, and be able to lead forth her Sons, saying—

"These are MY Jewels."

RUSKIN, *Unto this Last.*

THE HEALTH OF THE STATE.

CHAPTER I.

THE RISE AND PROGRESS OF PREVENTIVE MEDICINE.

"It is the province where Medicine joins hands with Common Sense."

SIR JOHN SIMON, K.C.B., F.R.S.,
First Medical Officer of the Privy Council.

THERE is nothing in the science of modern medicine more remarkable than the new development of the simple proverb that "prevention is better than cure." The bleeding and drugging of the old physician is giving place to treatment of disease by fresh air, simple living, suitable dieting, and a sane hygiene. More and more do we ally ourselves with Nature and, learning her secrets, her ways of doing things, endeavour to imitate her and work along the line of her laws. The wise physician is he who works not in opposition to her, but in co-operation with her. We are privileged to live in the midst of a great time, when we may daily witness the unfoldings of science to the furtherance and betterment of man's

existence. Above all, we are learning the solidarity and interdependence not of physical nature alone *but of human society*. We are learning that no man liveth unto himself. We are learning, though it be but slowly, that a diseased man is a danger to the State, and that the health of the State is one and the same thing as the health of the people. As Lord Rosebery once said, "the State is the aggregate of the individuals who compose it." Think of that idea in terms of medical science and you have before you the practical business and not ignoble ideals of the public health service.

The rise and progress of State Medicine, or the science of Public Health, is due to at least four factors, namely, the growth of our knowledge, the ravages of disease, the development of local government, and social evolution.

I. The Growth of Knowledge.

The art and practice of medicine possesses a history which runs far back into the records of man's life upon the earth. Probably the men who lived even before the time of recorded history made rude attempts to repair bodily injuries received from wild beasts or from one another in the fierce conflict of primeval life. We know that surgery was already an art when medicine proper was but a phase of superstition, and that both originated with the Egyptians. The first medical writing which has come down to us is known as the *Papyrus-Ebers*, which was written 3,500 years before Christ. It dealt with the preparation of various medicines "for all the corporeal parts of individuals." Two thousand years after that came the Vedas, the sacred books of India, containing its oldest records of the healing art; and

yet a thousand years later, that is about 500 B.C., we first meet with Chinese medicine, and in Greece with Hippocrates. This great man, who was the most celebrated physician of antiquity, was born in the island of Cos, probably about 460 B.C. He it was who began a new period of medicine by denying the supernatural origin of disease. Those before him had held universally that disease was the gift of the gods alone. Hippocrates was the first to teach that disease occurred "in conformity with nature," that it had natural causes, which he grouped under two broad divisions, first the influence of seasons, climates, water, situation and external surroundings generally, and secondly, those personal causes such as food, exercise, and the habits of the individual patient. The mighty influence of Hippocrates was followed by that of Galen, also a Greek physician, who was born in 131 A.D., and who became the first philosopher of medicine, with an influence which spread through East and West alike for more than a thousand years. Indeed, it lasted till the seventeenth and eighteenth centuries, down almost to our own day, and to the epoch making discoveries of modern times. It was at the beginning of the wonderful seventeenth century that Harvey discovered the circulation of the blood and it was at the end of the eighteenth that Jenner introduced vaccination for small-pox.

Earliest on the roll of the Fathers of Modern Preventive Medicine and belonging to the eighteenth century are the names of Richard Mead and John Pringle. The former discoursed on the contagion of epidemic disease and first showed the necessity of quarantine regulations, whilst the latter published in 1752 his classical work on the diseases of armies

and insisted upon the importance of military hygiene. They were soon followed by other investigators, who rendered similar service for the navy, and who in their turn gave place to the original workers in the domain of the *causes* of epidemic disease. On the whole it is true to say that of the advances in the public health which have been due to increase of knowledge, those have been greatest which are traceable to the mighty discoveries which have revealed for us the causes of disease. There was Jenner's work on the family relation of cow pox and small pox; Pasteur proved that all fermentation was due to living germs and that without living germs there was no putrefaction; and Koch and a host of workers took us a step further by demonstrating that infective diseases, such as tuberculosis, were also caused by similar living germs. The story of the growth of our knowledge of the unseen friends and foes which surround us is one of the most thrilling and romantic in the annals of science. It began in 1632 with Antony von Leeuwenhoek, the linen-draper of Delft in Holland, who with primitive instruments pursued science with enthusiasm, and in the long evenings after the day's work learned the art of grinding lenses and so was able to invent a microscope. Is it too much to say that the splendid microscopes of to-day are his great grandchildren? and that the patient workers of centuries were the fathers of the giants Pasteur, Koch, and Lister? And so it should not be forgotten, now that we build upon these foundations, that many humble and obscure contributors have by their industry and faithfulness added their quota to the mass of knowledge, even though one man appearing at the right

moment has drawn the conclusions and carried us from theory to fact, from experiment to law, and out of the darkness into truth. It has ever been thus in times of new learning and discovery. It is thus that science grows. Some men have laboured and we enter into their labours, others will follow us and enter into ours. The goal of truth is one and is reached by the conflict of opinion, by observation, by experiment, and by experience.

2. The Ravages of Disease.

There can be no doubt that the occurrence of epidemic disease is the opportunity for sanitary reform. That new occasions teach new duties has been abundantly illustrated in the history of epidemics in Britain. And in this connection we may think of four chief diseases which have ravaged our country in times past, namely, leprosy, plague, small pox, and cholera.

It is said that the loathsome disease of **Leprosy** was first introduced into England about the time of the arrival of Julius Cæsar, and subsequently during the crusades, but little is known of its occurrence until some hundreds of years later, when it was prevalent in Ireland, where leper hospitals existed in the ninth century. It was frequent in England and Wales in the tenth century and steadily increased to its zenith about the twelfth or thirteenth century, from which time it declined till its final extinction in these islands in the eighteenth. Not less than 200 "leper-houses" were established in this country, and many laws and regulations were made for the separation of lepers from the community, for feeding them by market-tolls at the gates of the

towns, and for providing for their isolated religious ceremonies. The occurrence of this disease was indeed the occasion of the first sanitary regulation in Great Britain, which was inaugurated even before the papal decrees in the same behalf. From the twelfth century onwards writs, municipal regulations, edicts, papal bulls, church canons, and royal proclamations followed each other with bewildering profusion, and all having for their alleged purpose the extermination of this dreaded disease.*

Even more widespread and fatal than leprosy was the **Black Death.** We know that this or some similar pestilence recurred continually in early times, and appeared as a European epidemic in 1349. It is most probable that this disease was similar to or identical with what is now known as *plague.* It came in 1348 with sudden and mysterious steps from Asia to Italy and so to Western Europe, carried some say by travelling merchants and others say by infected materials. It gained entrance at all events through the ports of Bristol and Southampton and spread over all the land, causing frightful ravages in 1349. It recurred repeatedly in the fifteenth and sixteenth centuries,

* *History of the Decline of Leprosy in the British Islands.* Newman, 1895.

† From 1896-1907 more than five and a half million persons died of plague in India, and the last of these twelve years was memorable for the most remarkable extension of plague throughout India ever known. The chief means of propagation are overcrowding, filth, and the conveyance of the infection by fleas on rats. As mosquitoes spread malaria so rat-fleas spread the plague. The disease is caused by a microbe (the plague bacillus), first discovered by Kitasato, a Japanese scientist, in 1894.

and still more in the seventeenth, culminating in the great outbreak of 1663-1665. There were not less than six thousand deaths per week in London alone during August and September of 1665, and according to Macaulay it swept away in England during six months as many as a hundred thousand human beings. In the following year, when Londoners were fearing what worse things could befall them, there suddenly appeared the most drastic of sanitary reformers, and the Great Plague yielded to the Great Fire, which consumed 13,200 dwelling houses, and made an end of the many-gabled convivial old city, "the stronghold of stinks and unwholesomeness." But this disaster was really a blessing in disguise, for fire is the chief of disinfectants, and befouled land, filthy houses, noisome alleys, unventilated and sunless courts, "and an infinity of ancestral frowsiness and infection" gave way to healthier conditions in the new London of Sir Christopher Wren. As the first outbreak in the fourteenth century led to great social and economic changes, so the epidemic of the seventeenth century was followed by advance in external sanitation.*

In the nineteenth century many of the preventive measures which were adopted had the occasion of their origin in the devastation wrought by small pox and cholera. The former disease was ever at hand, and the latter came in five chief invasions. For the abatement of small pox the chief instrument was vaccination coupled with isolation of the patient, and for protection against cholera central and local boards of health were

* See also *History of Epidemics in Britain*, by Charles Creighton, M.D. (1891).

established, quarantine was enforced, and the water supply was brought under protection.

Nor are the four diseases which have been named by any means the only illustrations of the part which disease plays in stimulating sanitary advancement. The old gaol fever (typhus), enteric fever, diphtheria, and other infectious diseases have each and all led to a development of general or special measures of sanitation.

3. The Development of Local Government.

In the third place, the advance of sanitation depends, in large measure, upon the methods and circumstances of government. From the earliest times there has been in communities some form of family or tribal authority, and our present complex system of government has grown from such simple beginnings. In the early days of England there were the "dooms" of the Kings, Ethelbert, Ine, Alfred and Canute, which led to the establishment of what came to be judicial tribunals, which, in their turn, were the forerunners of the manorial courts of the Normans and Plantagenets. Then, in the middle ages there was the rule of the guilds and of the municipalities interspersed, on special occasions, with edicts from the crown and bulls from the Pope. Then came Acts of Parliament, the first concerned with sanitation having been passed six hundred years ago. For it was in the reign of Edward I., to whose large statesmanship we owe our Parliament, that the first regulations were passed for the abatement of nuisances and the control of offensive trades. In 1297 for the first time every London citizen was required to cleanse the street before his own door. Sixty or seventy years later a law was passed for the

protection of water supplies, and in 1388 was enacted the first general sanitary statute.

After this supreme effort it seems that sanitary legislators slumbered for more than a hundred years. In the middle of the fifteenth century there was, however, an awakening, and various edicts and Acts were passed for the institution of "Commissioners of sewers," for the reclamation of marsh land, and for the provision of water supplies (*water-leets*). A hundred years later, owing to the ravages of the plague, we first meet with quarantine regulations (1636), and in the middle of the succeeding century the establishment of the factory system, and the enormous growth of the towns, brought that public demand for control which resulted in the marvellous advance in sanitary legislation, which characterised the nineteenth century, and particularly the great reign of Queen Victoria.

But it was not chiefly for the enactment merely of further Acts of Parliament that the nineteenth century was remarkable in respect of sanitary reform. It was most remarkable, first, for the decentralisation of responsibility, and secondly for the appointment of health officers, or as they are commonly called, Medical Officers of Health. It is a strange thing that in order to find a parallel reform or anything at all of the same kind, it is necessary to travel back 2,300 years to 494 B.C., when the Roman office of *aedile* was established, and the Eternal City was sub-divided into sanitary areas for purposes of public health administration. And even to-day as you approach Rome from the south by the Appian Way, long before you reach the gates of the city, you may see the ruins of the great undertakings of that golden age of sanitation.

They brought their water supply from the Alban and Sabine mountains by aqueducts, they utilised the vast quantities of refuse for agricultural purposes outside the urban area, and they buried their dead without the city wall. And within the city there is still the relic of the massive closely-fitted blocks of clean pavement, the complex but effectual drainage arrangements, and the baths and gymnasia which imperial Rome adopted from Greek example. Though twenty centuries have passed by, we have not advanced very greatly beyond the achievements of Appius Claudius in 300 B.C., and it is from the *aediles* and the urban police districts of his times that the medical officers of health and sanitary areas of our own day are directly descended.

It was, then, the cholera in 1831 and the Reform Bill in 1832 which first called into being boards of health, and made the Councils of local authorities both elective and operative for all urban communities. And the reform of the Poor Law in 1834 introduced life and activity into rural districts. This was the beginning of an unparalleled advance, due, in part, to the stimulation of public opinion, and the demand for social reform, and in part to a series of wonderful reports from Sir Edwin Chadwick, Dr. Southwood Smith, Sir John Simon, and Dr. Greenhow, on the sanitary state of the people of England.* In 1847 the first *aedile* or medical officer of health was appointed for Liverpool, and in the following year for the City of London. And from 1848 onwards, an almost ceaseless stream of Acts of Parliament have been passed concerning

* For the best account of the renaissance of preventive medicine see Sir John Simon's *English Sanitary Institutions.* (Cassell and Co. 1891).

public health. The tide set in with general measures for the removal of nuisances and the prevention of disease (in 1848, 1858 and 1866) which led up to the Royal Sanitary Commission of 1869, from which we date the establishment of the Local Government Board as the central office of responsibility and the appointment of local health officers throughout the Kingdom. From the early seventies onwards new enactments followed each other rapidly. In 1875 the sale of food and drugs came under control; a year later the Rivers Pollution Act; followed by a law concerning factories and workshops, and another dealing with the prevention of the contagious diseases of animals, and the protection of milk supplies; then came the Interments Act, the Water Act, the Canal Boats Act, the regulation of alkali works, the improvement of artisans' dwellings, and at the same period the great Public Health Act of 1875, which is still in force. And it was but a span of ten or twenty years, filled with minor sanitary legislation, which brought the new Housing Act, the legislation for the control of infectious diseases and establishment of isolation hospitals, the Local Government Acts and those great charters of liberty and of right, the London Public Health Act of 1891, and the Factory and Workshop Act of 1901. What different machinery indeed was all this as compared with Papal bulls and Tudor edicts!

4. The Social Evolution.

Lastly, it must not be forgotten that sanitary progress depends not a little upon the general advance of civilisation, and that alongside this forward movement in preventive medicine of which we have been speaking, and as a necessary fore-

runner of it, came the great social changes which have left their mark on England during the last two hundred years. We have not space to discuss these profound changes, but let us, at least, name them, that we may have them in mind and think of their effect. First there was *the increase in population.* At the end of the fourteenth century the population of England was between two and three millions; at the end of the sixteenth it was five millions; in the next century it doubled; in the next, it doubled again, so that the mighty nineteenth century began with twenty millions; and it ended, as we know, with forty millions. Consider what such increase means. It means an enormous growth of the towns; it creates all the acute sanitary difficulties due to a high density of population on a given area; it calls for new water supplies and involves a world-wide market for food; and it brings a hundred changes in its train, not the least being economic. Secondly, there was *the industrial revolution.* In the middle of the eighteenth century industry in England was domestic and agricultural. Spinning and weaving was done at home in the cottages. The man worked the loom, working what hours he pleased, and his wife and children spent the long evenings, when it was too dark to work in the fields, spinning yarn. There were no factories, no workshops, no machines. But in 1815 how complete is the change. We have the master and the mill. Men have become "hands," working long hours in the factories, and women and children take their place beside them at the machinery. This profound change was due to the great inventions. Hargreaves and his "spinning jenny" (1767), Arkwright and his "water-frame" (1769), Crompton and his "mule" (1779),

Cartwright and his "power loom" (1785), were some of the chief, and before them came Brindley's canals and after them the epoch-making development of steam power. And this revolution, not less than the increase of population, so intimately connected with the need of sanitary reform, brought unforeseen things with it.*

Then, in the third place, there have been great *changes in political thought.* The declaration of Independence in America and the French Revolution awoke in men's minds new thoughts of liberty. They were lessons in practical politics, which left only a little less mark on England than they did on America and on France. Men began to consider in what life consisted. They felt stirring within them new ambitions and new hopes, both of which were stimulated by the course of events in India. Nor was the nineteenth century disinclined to reap the harvest of the seed sown in the eighteenth. †

Lastly, it would be idle to suppose that amid all the social changes of the time, *the force of religion* was inoperative. On the contrary it cannot be doubted that the Methodist revival which began in 1738, and which was represented by the preaching of the Wesleys and Whitefield, followed as it was by religious revival of various kinds, contributed its quota, and that not a small one, to the advance of sanitary reform. For in the light of the "new humanity" poverty, vagrancy, disease, and vice came to be looked upon as evils to prevent. True religious revival is generally the forerunner of social

* See also *Industrial History of England*, by H. Gibbins. (Methuen and Co. 1890), and Arnold Toynbee's *Industrial Revolution.* (Longmans, Green and Co. 1894).

† See J. R. Green's *Short History of the English People* ("Modern England" Section).

reform. It was so in this case. John Howard undertook his "winter's journey" and drew the attention of Parliament to the need of prison reform; Sharp, Clarkson and Wilberforce grappled with the slave trade; Edmund Burke appealed, not in vain, for just government of dependent races in India; and Sir Samuel Romilly and Sir James Mackintosh began the early reform of criminal law. But most important of all the influences arising from religious activity was the betterment of personal life and the increase of moral responsibility.

CHAPTER II.

THE SANITARY GOVERNMENT OF ENGLAND.

"Governments, like clocks, go from the motion men give them; and as Governments are made and marred by men, so by them they are ruined too. Wherefore Governments rather depend upon men than men upon Governments. Let men be good, and the Government cannot be bad. If it be ill they will cure it."—WILLIAM PENN, Founder of Pennsylvania, 1682.

"First ask yourselves, 'What have I done for my education?' Then, as you advance in life, 'What have I done for my country?' so that some day that supreme happiness may come to you, the consciousness of having contributed in some measure to the progress and welfare of humanity."—From the last public address of LOUIS PASTEUR, 1892.

THE British Empire depends for its sustenance not upon dominions and territory alone but upon men, not upon markets alone but upon homes. For these are the vitals of a nation and springing from a wise control of them are the issues of life. And if this country be, as it has been happily termed, the heart of the Empire, we cannot afford to ignore the fact that it is upon a just and free system of local government that the real welfare of a world-wide State depends. Nor is local government only an affair of rates and taxes, or

water supplies and sewerage, or birth registration and burials. It is a system of co-partnership between those who govern and those who are governed in the interest of the whole composite life of a nation. It was Edmund Burke who first extended our vision of the manifold operations of the State and the breadth of its basis. He told us that it was "not to be considered as nothing better than a partnership agreement in a trade of pepper and coffee, calico or tobacco, or some other such low concern, to be taken up for a little temporary interest and to be dissolved by the fancy of the parties. It is to be looked on with reverence, because it is not a partnership in things subservient only to the gross animal existence of a temporary or perishable nature. It is a partnership in all science; a partnership in all art; a partnership in every virtue and in all perfection. As the ends of such a partnership cannot be obtained in many generations, it becomes a partnership not only between those who are living, but between those who are dead and those who are to be born."*

English government then is based in large measure upon two general principles. The first is that all responsible citizens shall have a share, directly or indirectly, in the government of the country. The second is that the whole system of control shall be based upon local autonomy, the network of local government areas (*local authorities*) being knitted together by, and made responsible to, central departments of State. The means necessary for the carrying on of government are supplied by rates and taxes, and the members of the community who actually do the work are: (1) elected representatives who render voluntary

* "Reflections on the Revolution in France."

services to the State and (2) a number of more or less expert permanent officials who are paid for their services. The Empire is thus built upon local government and upon free and representative institutions.

The Machinery of Government.

It will be convenient to tabulate the various bodies which now exist for the carrying on of government, particularly in regard to public health administration.

1. The Crown.
2. Parliament, for legislative purposes.
3. Central Departments of State.
4. County Councils.
5. Local Authorities (Sanitary Authorities).
6. Parish Councils.
7. Poor Law Unions.
8. Special Bodies for Special Purposes.

The pyramid which is thus based on local government has its apex in the Crown or monarchy, the supreme head of the State, whose public action is limited by Parliament, which in its turn is the supreme legislative body. Then come the central departments of State, of which five may be named as directly concerned with the public health. First there is the *Local Government Board*, which was created in 1871 to concentrate in one department the chief powers as to poor relief, public health, and local government generally. The Board has a President (with a seat in the Cabinet) who is assisted by parliamentary and permanent secretaries, and a large staff including many experts. Some of its chief powers concern poor relief, but it possesses extensive powers respecting public health, it has special authority to deal with epidemics of disease, and it watches over the financial operations

of various local bodies. Secondly, there is the *Home Office*, established in its present form in 1801, and presided over by the principal Secretary of State. As far as public health is concerned, the Home Office administers factory and workshop legislation, controls the police, supervises the administration of certain Acts of Parliament (including the Burial Acts and the Employment of Children Act), and deals with the large housing schemes of the metropolis. Thirdly, there is the *Board of Education* which supervises the hygiene of schools and school children. Then, fourthly, there is the *Board of Agriculture and Fisheries*, which is concerned with the Diseases of Animals Acts and, in part, with the protection of the food supply. Fifthly, though not a central department of government, like the other four which are presided over by Ministers of the Crown, there is the *General Register Office*, controlled by the Registrar-General. This is a most important central body from a public health point of view, for it collects all the returns as to population, births, marriages, deaths and the causes of death (*vital statistics*), and without these facts it would be impossible to measure the effect of sanitary measures or apply them to the needs existing. It should be added that the central departments of State act by means of Orders and Regulations, by the approval or otherwise of special powers or Bye-laws, by control of officers, by inspection, and by the guidance of local administration and the issue of information.

Local Government Bodies.

And now we come to the first form of local government body, concerned with the

affairs of its own district only, namely, the *County Council*, created in 1888. There are now sixty-two of these bodies, to which members are elected by all ratepayers in the county who occupy premises of the yearly value of not less than £10, and who have lived in the district for twelve months. But generally speaking, it may be said that outside London, contested elections for a county council are few. Much the same social class of representative sits on the County Council as supplies the bench of magistrates. In public health matters these councils are mostly advisory and their chief work is done on Committees. They exercise a certain amount of supervision over the work of the local bodies within their county.

Perhaps the most interesting of all these bodies are the *Local Authorities*. They are the Sanitary Authorities and include county boroughs, municipal boroughs, and urban and rural district councils. They are some 1,800 in number, and the network of them covers the face of England.* There is no district, village or hamlet which does not come within the boundary of some local authority. Each urban authority consists of a council, consisting only of members elected either one-third in each year or all every third year. Women are eligible and there are no aldermen. The electors are all ratepayers, including women who have rateable occupation. Rural district councils are similarly appointed but serve also as poor law boards. The duties of the sanitary authorities in respect to public health are very extensive. They form the

* Approximately there are at the present time about 800 urban district councils, 650 rural councils, 320 town councils, and 28 metropolitan councils.

unit of administration for all such purposes, and are responsible for the following :—

Collection of Vital Statistics.
Prevention of Preventable Diseases.
Provision of Hospital Isolation.
Disinfection.
Protection of Food.
Control of Milk Supply.
Water Supplies.
The Housing Question.
Sanitation in Factories.
Workshops and Work-Places.
Drainage and Sewerage.
Abatement of Nuisances.
Removal of Refuse.
Control of Offensive Trades.
Administration of Sanitary Law.

Next to the Local Authorities come *the Parish Councils*, of which there are more than 7,000, concerned with the maintenance of footpaths and rights of way, the Allotments Acts, libraries, burial grounds, lighting, etc., and if the district council neglects its work the parish may appeal to the county authorities. The *Boards of Guardians* in rural districts are the rural district councils, but in urban districts are separate bodies, having for their object the administration of the poor law, and the practice of vaccination. This last function is a curious anomaly. Then, lastly, there are *special bodies* for particular purposes, as for instance water boards, hospital boards, river boards, and port sanitary authorities. Districts may combine to form representative boards for the purposes of supplying and protecting water (*e.g.* the Metropolitan Water Board) for the provision of hospitals for the isolation of cases of infectious disease (*e.g.* the Metropolitan Asylums Board), or for the protection of rivers from pollution (*e.g.* the West Riding of Yorkshire Rivers Board) or for the exercise of sanitary measures at ports to prevent the

introduction of infectious disease from other countries (*Port Sanitary Authorities*).

How Local Authorities Work.

The work of these local government bodies is then to deal with the broad common-sense requirements, as dictated by science and human experience, for the extension of the frontiers of life. They carry out much of their public health work by means of paid officers. The members of the Authority give their services freely to the State, but as such services are not obtainable permanently, and would not always meet the needs of the work, these Councils appoint various experts to carry out their instructions or the requirements of the law. They must appoint a Clerk, a Medical Officer of Health, a Sanitary Inspector and a Surveyor. Frequently the last two posts are held by one and the same person. There is usually also a treasurer or accountant. It is these officers who carry on the routine work of the Authority, and to understand the public health portion of it we must consider what are the duties of the medical officer of health and sanitary inspector.

The Medical Officer of Health is, as the term implies, a medical man. Since 1892 no person can be appointed Medical Officer of Health for a district or town having a population of 50,000 or upwards unless he is qualified in medicine, surgery, and midwifery, and also holds a Diploma in Public Health (D.P.H.).

Broadly, it may be said that a Medical Officer of Health has duties of administration, of advice, of inspection and investigation, and of reporting, and all are summed up in the chief purpose of his work, which is the *prevention of disease*. The respective work of his staff has to be arranged and guided ; laws have to be administered and enforced ; and the

public health department controlled efficiently. The Local Authority frequently requires the expert advice of the medical officer, which is also often called for by the Central Authorities. Much of his time is also occupied in investigation of the causes and channels of disease, in tracing out epidemics and in taking measures for their prevention. And upon these various matters it is his duty to report to the Local Authority, the County Council, the Local Government Board, and the Home Office. Year by year the reports of the public health service furnish the nation with an immense body of facts which are too often ignored. Yet out of them springs future action and the substance of future laws. An annual report is issued for every Sanitary Authority, and responsible citizens of each district would do wisely to obtain a copy every year and study it.

The Sanitary Inspector (or "inspector of nuisances" as he is sometimes called) is the chief agent of the Medical Officer of Health. His qualifications for the post are obtained after examination by the Royal Sanitary Institute or the Sanitary Inspector's Examination Board.

What does a Sanitary Inspector do? He inspects. There is hardly anything he does not inspect—houses, rooms, cellars, yards, curtilages, workshops, factories, restaurants, food shops, cowsheds, dairies and bakehouses, anything and everything which may exert an effect on health. It is his duty to abate and prevent nuisances as far as may be, to take samples of food for examination by the analyst, to watch for smoke nuisances, to supervise drainage and all other sanitary improvements which are being carried out. Canal boats also come under his supervision, and all factories, workshops, and workplaces. There are now, in addition to ordinary male inspectors, a number of women inspectors and lady health visitors employed by the Home Office or by various Local Authorities. They are variously qualified, some of

them having been medically trained. Their duties include the visitation of women's workshops, home workers, sick children, and so on. Quite recently they have also been employed in administering the various means for the reduction of infant mortality.

Voluntary Work and the Public Health.

We have already seen that many voluntary workers take a share in the sanitary government of the country in the capacity of members of councils. But there is also considerable scope for a more direct voluntary health service. Some of the larger cities possess *sanitary associations* (as in Dublin, Edinburgh, Liverpool and Manchester, where the Ladies' Health Society has done good work), which carry out a large amount of sanitary work (Sanitary Aid Committees), and aim at creating an educated public opinion and stimulating the local authorities on these matters. Then at Bradford, Halifax and other towns there is in operation an excellent institution, *The City Guild of Help*, a society of voluntary workers on the lines of the Elberfeld system. In London there is the *Mansion House Council for the Dwellings of the Poor* (31, Imperial Buildings, Ludgate Circus, E.C.), the *Kyrle Society* (2, Manchester Street, W.), the *National Health Society* (53, Berners Street, W.), the *Royal Sanitary Institute* (74a, Margaret Street, W.), the *Smoke Abatement Society*, the *Garden City Association* and many other like societies, having for their object the improvement of the sanitary condition of the people. To help forward these and similar movements is to advance the health of the community. For the sanitary government of England does not rest wholly with local authorities or with boards of health. It is a matter of the highest general concern depending for its

efficacy upon the whole body of citizens in each community.

How can the citizen help? One of the more direct ways of assisting, is to co-operate with the sanitary authority, which is a method happily adopted by many of the Societies just named. The destruction of the poor is not only their poverty but their ignorance and helplessness. And the difficulty is not so much that there is none to help as it is to bring those needing help to the helping agencies. Consider for a moment what discomfort and disease is brought about in the homes of the poor by such things as the following :

Animals kept by neighbours in such a way as to be a nuisance ; the absence of a dust bin ; an unpaved back yard or area ; refuse or manure accumulation ; an insufficiency or unsuitability of sanitary conveniences ; an offensive privy ; a filthy cistern ; an unclean street, court, or alley ; damp rooms or a damp house ; dilapidated houses ; defective drains ; the presence of infectious disease in a tenement house ; no water supply ; a polluted well ; absence of ventilation in the rooms of the house ; a dead body having to be kept previous to burial in a one roomed home ; verminous bedding ; filthy rooms ; a noxious trade in the adjoining house ; unsound food or watered milk ; smoke nuisances, etc. Or consider the risk which a worker runs who is employed in a hot, dirty, stuffy workroom, or one which is cold and damp, with very indifferent sanitary accommodation or none at all.

Now in all these unlawful conditions information should be addressed, anonymously if desired, to the Medical Officer or sanitary inspector of the town or district, and the machinery which exists will be put into motion. Thousands of nuisances continue because no information is sent to the authorities. Such communications should be addressed "The Medical Officer of Health for [the town or district in question]" if the address of the Town Hall or Municipal offices is not known. Complaints respecting factories should be addressed to the Chief Inspector of Factories, Home Office, London.

So much for the powers and problems which fall into the hands of the workers in local government. To make such government effectual there are two essential requirements. First, men of superior

education and intelligence who will come forward throughout the country and take part in its voluntary work; and secondly, a well-informed public opinion, alert, awake and watchful.

The Irreducible Minimum of Public Service.—A study, however, of the operations of municipalities since 1869 reveals two disabilities in not a few of those citizens selected by their fellows to bear the burden of local government. The first is lack of capacity and the second is vested interest. The lack of capacity shows itself, perhaps, mostly by a failure to foresee, a narrowness of outlook, of training and of temperament, and the absence of certain indefinable qualities of head and of heart. Vested interest on the other hand, shows itself by a greater or less degree of that mistaken ideal represented most obviously in this country by the motto, "Our trade, our politics." Keen tradesmen may be and often are excellent citizens, but when they allow their virtues to become partially or wholly eclipsed by their prejudices and trade interests, materialism presents itself in an evil form. And what is true of these men is true also of their constituencies. For though there is ample sign of vast social improvement in the life of the people and an advance of which our forefathers never dreamed, still it must be said that selfishness, vested interest, negligence, carelessness, and apathy, are not less than of old. It is integrity in its broadest meaning which would enable electors and elected to discharge their duties in more adequate fashion.

Looking to the excellent results that are obtained by the normal type of municipal organisation, the Physical Deterioration Committee actually report that where English Local Government fails

" it would seem *that it is not so much the instrument that is in fault as the impulse behind it.*"*

No criticism could be more accurate and justifiable. For what do we find ? We find that the privilege and duty of the electors to vote for their representatives—what Lord Rosebery has called the " irreducible minimum " of public service—is not exercised as it should be by a free people governing themselves. For instance, the figures of the returning officers for the last four elections in the metropolis are as follows :—

Election.	Percentage of Electors who voted.
Poor Law Guardian Election, 1904 ..	23.6†
Borough Council Election, 1906 ..	48.2
London County Council Election, 1907	55.0
Parliamentary Election, 1906	77.0‡

These figures present a forlorn picture of local representative government—a method of government obtained for us at the price of a great struggle and of great sacrifices.

If things are not as the people desire them to be, it is idle for them to complain until they have exercised the powers they already possess, and have done their proper share to furnish an impulse behind the instrument.

* *Report* Vol. I. pp. 15-23.

† In spite of the fact that expenditure on poor relief in London amounts to nearly four millions per annum or 16s. per head of the population. In many places in England and Wales only fifteen per cent. of the electors go to the poll, though the total expenditure on poor relief is £13,851,981 or 8s. 2½d. per head of the population. (1905.)

‡ It is generally admitted that this was an exceptionally high figure. The usual percentage is between 60 and 70.

CHAPTER III.

THE PROTECTION AND VALUE OF FOOD.

"Wherefore it appears to me necessary to every physician to be skilled in nature, and to strive to know, if he would wish to perform his duties, what man is in relation to the articles of food and drink."

HIPPOCRATES. 460 B.C.

IT is obvious that the question of food is of vital importance to the health of the people. There is probably no other single factor which more directly affects their physical well-being than the quality and amount of food which they consume. No doubt there are many social factors and conditions which affect both quality and quantity, but primarily the physical condition of the adult depends upon his food. The subject may be suitably considered under four sub-headings dealing with the use of food in the body, the amount necessary, its kind, and its protection.

(a) The use of food in the body.

Hutchison distinguishes four tests of the value of a dietary to the human body. There is first the chemical criterion turning upon the nutrition and strengthening of tissues derived from various articles of food; then, secondly, there

is the physical which measures the value of a food by the degree of heat produced by its action; thirdly, there is the physiological standard to be met, which in other words is the suitability of a food from the point of view of digestion; and lastly, there is the economic or nutritive value of food as compared with its cost.* Now whilst these four criteria are concerned with the value of a dietary from different standpoints, they indicate to us in the main the two chief uses and objects of food in the human body, namely, (1) to repair the body and build up its tissues, and (2) to produce energy in the form of heat to keep the body warm and in the form of power for the work it has to do. The substances in food which build up the muscle, bone, blood, and tissue of the body are nitrogenous and are called *proteins*, those which produce the heat and energy are starch, sugar (*carbohydrates*) and fats. These latter serve, so to speak, as fuel to the machine. There are also *salts* such as lime, potash, and soda, and combinations, as phosphates, etc., which are bone builders. Though this division is made there is no hard and fast line to be drawn, for protein helps to produce energy and fat helps to produce tissues. They all, therefore, yield energy in the form of power and of heat.

(b) The amount of food necessary.

This yield of energy of which we have been speaking is now used as the most reliable test of the amount of food necessary for health and for the doing of hard work. Instead of saying we need so much protein and so

* *Food and the Principles of Dietetics*, by Robert Hutchison, M.D., F.R.C.P. (Arnold), 1902.

much starch and fat we simply say *we need so much heat.* The heat produced by the protein, fat and so on is a better indication of correct quantity than the actual amount of protein and fat, because the value of those to each individual body is different and the stuffs also differ in standard themselves. So we measure by heat, and the unit of heat we use is termed a *calorie,* which is the amount of heat required to raise one pound of water four degrees Fahrenheit (or, if it be stated on the French scale, one litre of water one degree Centigrade). When we thus express the potential energy of food we do not mean that all its energy takes the form of heat, but that if it were converted into heat a certain number of calories would be the result. Now it has been shown that for active bodily work 2,500-3,000 calories of energy are necessary every day, so we ought to consume the amount of food which will produce that amount of heat. But in addition we must provide for the upkeep and repair of the tissues of the body. So that we must eat food which yields sufficient building material as well as sufficient heat, and this has been found to be about 3-4 ounces of protein, 2½ ounces of fat and 18 ounces of carbohydrates, making a total of about 24 ounces of dry food. This abundant amount of food will yield the necessary calories and sufficient building material. If very hard work has to be done food should be eaten which will yield more calories. For hard work all the chief constituents may be increased, but there is evidence to show that the most valuable source of muscular energy is carbohydrate. For mental work the digestibility of food is of greater importance to the brain worker than chemical composition. It need

hardly be added that women require about 500 calories and children 1,000 calories less than men.

(c) The kind of food.

This is the next question to be considered. In other words what food shall we take to obtain the desired results in heat and repair of the body. This may be expressed most conveniently perhaps in a few hints respecting the common articles of diet used by everybody, because as a matter of fact dietaries differ but little in essentials. They differ in regard to the fancy articles which persons add on to the essentials, if they have the money to buy them and if they like them. The articles which are essential and of which everybody eats more or less, are bread, meat, fish, cheese, butter, milk, sugar, oatmeal, vegetables and so forth.

Now, if we measure these foods by their protein or building power, by their energy value, and by the amounts of useless and unnourishing material which they contain, we shall arrive at a few simple conclusions which may serve to guide us in our selection. *Bread* is one of the most valuable of all our foods, and has naturally come to be looked upon as "the staff of life." It is, of course, made of flour, of which "seconds" though poor in colour is, on the whole, the best form. "Whites," and "patents" make less satisfactory bread. Crust, toast, and biscuits are more easily digestible than new bread. All bread should be well chewed, and because it contains too much sugar and starch in proportion to its protein it is better eaten with cheese, dripping, or herring than with jam, treacle, or sugar. *Meat*, whether beef, mutton or bacon, contains a good deal of waste

matter and no carbohydrate. Yet it is one of the few articles of diet on which life can be supported alone for long periods. It is, however, an expensive food to use, and people with small incomes should eat less meat and make up in protein, which is the most important element of meat, by eating cheese, fish, peas and beans. The digestibility of meat is improved by cooking, but not by overcooking. Liver contains a proportionately high percentage of protein and also a little carbohydrate. It requires considerable chewing for it is otherwise indigestible. Bacon is better than pork in an ordinary diet, its fat is more digestible and of great value in making up the necessary fat of a dietary. Sausages are a useful form of meat food, but as has been truly said they resemble human life, for you never know what is in them till you have been through them ! Frozen meat, if good, is equally wholesome and satisfactory with fresh meat.* The value of *fish* as a source of energy depends largely upon the amount of fat which it contains. Eels contain a high percentage of fat but are low in protein. Cod, turbot, soles and trout are just the opposite of this. One of the most all-round valuable fish foods is the herring, which is both economical and nourishing. Two salt herrings contain as much animal protein as need enter into the daily dietary of an ordinary working man. Salmon, mackerel, sprats and sardines are also excellent fish foods. *Cheese* is one of the cheapest and best forms of protein,

* The English working man is relatively a large meat eater and spends from fifteen to eighteen per cent. of his total expenditure on meat, the largest item in his weekly budget. He consumes more meat than French, German or Belgian working men, who each devote about nine per cent. of their expenditure to meat foods.

though not readily digestible. It contains a relatively large amount of protein and fat, indeed all the casein and nearly all the fat of milk, and may be used in various way in a dietary in the form of cheese puddings, biscuits, gratings or macaroni cheese (as used in Italy). The cheaper cheeses, Canadian and Dutch, and English "Singles," are often more nourishing than the expensive ones (Stilton and Gorgonzola), which are bought chiefly for their flavour. Cheese is even better as a food than beef, and weight for weight yields three times more calories than lean beef, and equal nourishment can be obtained from cheese as from beef, at about one sixth the cost. On the whole cheese is one of the very best of all our common articles of food. *Milk*, of course, is also an excellent food, though by no means perfect. Its chief use is for children. It has been estimated that a quart of milk at 3d. or 4d. is as nourishing as a pound of beefsteak at a shilling. In milk, as we have seen, we get fat, protein and sugar. Nor should we despise skim milk (milk without its cream), which is a cheap source of protein, but it should be used with foods which are rich in sugar and starch, such as bread. It has been shown that ten ounces of bread and a pint of skim milk, costing 2d., produces 925 calories as against 940 produced by an ordinary restaurant lunch costing eightpence. Milk is a food, not a beverage, and is the most important single article of diet in disease. Butter is expensive and not particularly nutritious, though its large percentage of fat and ready digestibility make it useful, and particularly so in a dietary during illness.

A word may be added in respect of some general foods. "Oats may be regarded," Dr. Hutchison

says, "as the most nutritious of all cereals," and there can be no question as to the value of a plateful of oatmeal porridge and a third of a pint of good milk. "Quaker oats" are said to be one of the best of the prepared forms. Tapioca and sago are also foods well worth the price paid for them, but vegetables have but a low nutritive value, though they are useful from the point of view of variety, of mineral salts, and of vegetable acids. Their usefulness in preventing scurvy has long been known. Tea, coffee and cocoa are the commonest non-alcoholic beverages, the last-named is a food, and all have a mild stimulant effect. They should be used sparingly and sipped rather than quaffed off. Ten or twenty cups of tea daily is too much. Many folks allow themselves a diet of tea and bread for all meals, and this, of course, leads to nervous conditions and dyspepsia. To make tea properly it should be *infused*, not boiled or stewed; bring the water just to the boil, thoroughly heat the teapot, pour the water on the tea leaves (a teaspoonful for each person is not a bad standard) and limit the infusion to about four minutes; some good tea-makers then pour the tea into another hot teapot. Coffee should be made strong and hot, from freshly roasted berries ground in a clean grinder, or from a good ready-ground coffee.

The cost of food will of course depend entirely upon the kind and quantity used. Mr. Seebohm Rowntree has shown that the average in York, which may be taken as a representative provincial town in such a matter, works out at 3s. each per week for adults and 2s. 3d. each for children.* These

* *Poverty, a Study of Town Life* (1901), pp. 103-106. Professor Chittenden holds that less protein is necessary than is estimated for in these amounts.

prices refer solely to the cost of the food materials of a standard diet ; they include none of the necessary expenses connected with cooking and preparation, nor do they allow for the waste which in practice occurs through bad choice of foods. From what has been said it will be obvious that money paid for food is, unfortunately, often spent very wastefully, in response to silly advertisements or because of ignorance, and among the necessary reforms in the domestic life of the people at the present time, not the least important is food reform—the money laid out upon, and the selection and cookery of food.

(d) The Protection of Food.

We now come to the large question of the control of food from a public health point of view, a matter which every year becomes more difficult, because the sources of the nation's food become more remote, and because food passes through an ever increasing number of hands. Think of the origin of the articles on our tables. The tea comes from India and China, the coffee and sugar from East and West, the wheat from the vast granaries of Canada,* the bacon from Denmark, the hams and beef and preserved meats from America, the mutton from the ranches of New Zealand,† the fish from the North Sea, the butter and cheese from all parts of the world, the milk from the country districts of England, cloves,

* The quantity of wheat consumed annually in the United Kingdom is thirty-three million quarters, of which only seven million are grown in this country.

† Our import trade of meat is valued at £40,000,000 per annum, of which £7,000,000 comes from British colonies. New Zealand sends four million frozen carcases of mutton every year.

spices, olives, tinned fruits, bananas, and oranges from the sunny lands of the tropics. What labour there has been on the part of many men in many lands to furnish our tables even with the simplest articles of food. Our forefathers ate home-made rye bread and occasionally a bit of pork. We live on a variety of foods sent hither from every mart and market in the world. Truly, we are interdependent upon each other as never before, and we require as never before, for our very food supplies, open markets and international peace.

Now it is this extent of gathering ground which partly complicates the work of food protection. But there are other things also. Owing to the growth of the towns food has to be kept for long periods before consumption, and this creates a temptation to add preservatives or involves a risk of decomposition. Then much of our food is now-a-days tinned or placed on the market in some prepared form which may affect its quality. Much of it, too, comes from places over which there is no sanitary control or is handled by unclean or unscrupulous persons. Lastly, there are hidden dangers in regard to infection. And so it comes about that it is necessary for the State to protect its citizens from unsound or unsatisfactory food, in order that (*a*) food may be of the proper nature and quality; (*b*) of good nutritive value; (*c*) and free from infection or poison. We may, at once deal with the first two reasons for control of food. The Sale of Food and Drugs Acts lay down that "no person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser." This seems so reasonable as to be almost unnecessary, indeed a

minimum of justice, and yet it is surprising how necessary it is to guard the buyer from buying what he does not want. He goes into a shop to buy food. He asks for a pennyworth of milk, but he may get a farthing's worth of milk and three farthings' worth of water, or milk without its cream, or milk even with chemical preservatives added into the bargain without any extra charge! He asks for butter, but he may get margarine or he may get butter and milk and water, all mixed together under the attractive title of "best blended butter"! He asks for coffee and gets chicory, or for sugar and gets adulterated crystals, or for whisky —and not even then gets what he wants! And so there is need for stringent laws to safeguard the purchaser and to require that in every district there shall be regular testing and sampling of food. In 1905, in England and Wales persons were caught selling food in some way adulterated in 7,099 instances. Legal proceedings were instituted in 3,581 of these cases, and fines were imposed, amounting to £6,146.* No doubt most of the criminal vendors escaped, for sampling at present only touches the fringe of the evil of food adulteration.

What is even more difficult to control is infected food. Of milk we speak in the next chapter. It is one of the most readily infected foods, but it is not alone. Meat may convey disease, especially in some of its prepared forms such as sausages, tinned meats, and pork pies. Oysters, cockles, and shellfish too are sometimes guilty,—and the same must be said of ice cream, infected watercress and even cheese. Some people think it will soon be difficult to know what to eat with safety! But things

* Thirty-fifth Annual Report of Local Government Board, 1905-1906, p. cii.

happily are not as bad as they sometimes appear, and good and thorough cooking covers many risks.

Ptomaine Poisoning.

In 1880 a large number of persons were taken ill at Wellbeck, in Nottinghamshire, after eating some ham at a public luncheon. They suffered acutely from the ordinary symptoms of " ptomaine poisoning," such as colic, diarrhœa, vomiting, rigors, fever, headache, cramps in the limbs, prostration and so forth. In all there were seventy-two cases of illness, four of which, unhappily, proved fatal. The ham had a disagreeable taste, but was not suspected to be tainted. It had, however, been exposed to sewer air in some place of storage. This outbreak was called " Welbeck disease," and drew attention to the dangers of eating infected food. A specific microbe was found in the ham. In 1881 another outbreak occurred at Nottingham, when fifteen persons suffered illness after eating baked pork. Since that date more than fifty epidemics of a similar kind have been investigated. They have generally possessed certain well-known features. There have been in all of them for instance simultaneous attacks, precisely similar symptoms, a history of infection by the same food as the only article eaten by all the persons attacked, and the same sort of incubation period. The incubation period (see p. 72) is generally, though not always, short (a few hours). There is another peculiar thing about these outbreaks, and that is that the meat most frequently involved is pork. It appears that unclean or uncooked pork is just about the most risky kind of meat to eat.*

* *Hygiene and Public Health* (Whitelegge and Newman, 1905), pp. 101-106.

An ounce of example is worth a pound of theory, hence it may be well to give some particulars to illustrate the kind of thing that happens. In 1901 I got involved in a cheese-poisoning outbreak in this way. One day in October a man complained to me, as Medical Officer of Health, of some cheese he had eaten, and he produced evidence that several acquaintances and neighbours had suffered also. A piece of the cheese was sent for. It appeared to be in excellent condition, with delightful flavour and pleasant taste, and the story seemed incredible. I therefore nibbled at this cheese with enjoyment, and it was soon all gone. Four or five hours afterwards, however, I was filled with regret, remorse, and pain, suffering from the same symptoms as the other consumers. Next day, it seemed only right that the man who sold this cheese should also be encouraged to try it. He did so with alacrity, and in order, as he remarked, to demonstrate that these illnesses had no relation to the cheese in question, he was persuaded to eat six ounces of it. On the following day, he too was filled with humility and remorse, and was compelled to leave his work. Altogether there were seventeen of us who owned up to the disadvantages of this particular cheese, which was part of a consignment from Holland, which was widely distributed over England and no doubt resulted in a good deal of individual unhappiness. The poison it contained was afterwards shown to be *tyro-toxicon*, a poison in cheese which in 1883-1884 affected 300 persons in Michigan, U.S.A. They do these things on a big scale in America !

An outbreak of a more serious character came within the writer's experience in 1902, when twelve boys contracted typhoid fever from eating ice-cream from a hawker's barrow in the street.

One other instance may be mentioned. In 1906 a batch of pork pies was made in a small cook shop in a Midland town, and sold to any who came to the shop. One went to a family of eleven persons at

Bedford, eight of whom partook of it, and all became seriously ill ; another went to a second family in the same town and three out of its four members were poisoned ; another was partly eaten by a gentleman travelling to Derby, who was likewise poisoned ; a fourth went into Buckinghamshire and was eaten by four persons, each of whom became ill ; a fifth went to Blisworth and poisoned a whole family of six persons, a visitor at the house who ate no pie being the only one to escape ; a sixth caused illness in Northampton ; a seventh resulted in two cases of poisoning near Rugby ; and an eighth was eaten in a Y.M.C.A. camp in the country, and four young men regretted its consumption. Here, then, was a widely distributed infection. When a piece of one of these pies was carefully examined by an expert bacteriologist, two species of microbes were discovered, which are associated with filth (*B. coli* and *B. enteritidis*). "The presence of these two bacilli in a pork pie of this description," wrote the bacteriologist, "is due to the use of unwholesome meat ; the cooking of the pie would suffice to sterilise the external crust, but the heat might not penetrate sufficiently into the centre of the mass of meat to destroy any bacteria which might be there, and the meat would afford an excellent medium for the multiplication of any bacteria which might thus have escaped destruction, and which would afterwards grow through to the crust. The occurrence of bacteria of this description within a pie is an indication that either *diseased meat* or *imperfectly cleaned offal* has been included among the ingredients." And he might have added a third alternative, namely, preparation of the pork pie under insanitary conditions.

These are, in point of fact, the three main causes of these sort of epidemics : (*a*) diseased materials ; (*b*) imperfectly cleaned materials ; and (*c*) insanitary premises. In 1902, in Derby, 200 persons were poisoned by eating pork pies made, as it was

subsequently shown, either in insanitary premises or from dirty materials. These are the conditions which lead to the entrance of filth-microbes to such a food as this, and which serves as an excellent nidus for the growth of bacteria and the manufacture of their products known as *toxins* or *ptomaines*. The first of these terms reminds us that these poisonings are intoxications more than infections, as it is the products or poisons themselves which are consumed rather than the bacteria ; the second term explains why these outbreaks are usually described as *ptomaine-poisoning*.

Prevention of Ptomaine Poisoning.

The question naturally arises, How can these things be prevented ? The answer is threefold.

First, only good meat should be used in preparations for human food.

Secondly, the process of preparation should be carefully controlled.

Thirdly, the premises in which food is prepared should be sanitary.

To obtain the first we cannot, unfortunately, always trust the salesman. It is necessary to have (1) vigilant and skilled inspection of meat by well qualified officers. To make such thorough inspection practicable we need (2) public slaughter-houses and the gradual extinction of private slaughter-houses. Then (3) all carcases which have been passed as good should be marked, and (4) the same conditions should apply to all imported meat. These are the four urgent needs. At present inspection is worked on the detective system, catching bad meat when we can. But with an increasing meat consumption and an increasing importation from abroad, it is really time the whole

thing was properly organised. Imported meat per head of the population in this country in 1870-1872 was 14.6 lbs.; in 1900-1902 it had risen to 56.6 lbs. A great deal of this is absolutely uninspected and comes from uncontrolled sources.*

Meat may be unsuitable for food either because it is decomposed or because it is diseased. The former is known by four signs, its colour, its smell, its appearance, and its consistence; the latter is known by the particular signs of disease such as marked wasting, diseased lymphatic glands, diseased organs, etc. Good meat should be firm and elastic to the touch, of healthy colour, free from purulent matter and bad smell, and should exude a healthy looking, blood-stained meat juice. It should be kept covered or stored in a cool, clean place, free from smell.

Oysters and Shell-Fish.

There are two other kinds of food poisoning which must be briefly mentioned, namely, shell-fish and tinned goods. Shell-fish and oysters have, unfortunately, got badly into disgrace in recent years. In 1894 Dr. Newsholme, of Brighton, found that a number of cases of typhoid fever were contracted apparently as a result of eating infected oysters. Some college suppers in America produced an outbreak of the same disease, traceable to the same source. In 1896, evidence came from France to the same effect, and in that year, Dr. Bulstrode, of the Local Government Board, made a special inquiry into the whole subject. It was proved that the typhoid bacillus could live in sea water for many days, and that oysters from beds contaminated with sewage contained infective

* *Public Health*, November, 1906, pp. 65-86.

microbes. Then there came, in 1902, the terrible accidents at the mayoral banquets at Winchester and Southampton, when, in separate towns on the same day, 117 persons were poisoned by eating infected oysters, which had been fattened on a sewage-polluted oyster bed, which had previously been condemned. Cockles and other shell-fish have also been found guilty of occasionally spreading disease. At present there is no power of control over oyster layings, nor any power to prevent the sale of polluted oysters, nor even power to prevent the importation of contaminated oysters. We are, at present, protected only by that most uncertain and unjust defence, "a scare."

Prepared Foods.

We are in much the same position over tinned foods: potted meats, sausages, and such articles. We have had "revelations" from America in *The Jungle* book, and there is abundant evidence that in England, too, unsatisfactory things get into these manufactured goods, but we muddle on in true English fashion. Even in London tuberculous pus has been found on its way into widely-advertised sausages, diseased horse flesh has been prepared for potted meat, and decomposing animal matter made up into "potted salmon and shrimp."* Of course, such unpleasant cases are exceptional; it is not the rule to make sausages, potted meat and "salmon and shrimp" from these constituents. Still the fact remains that these things do occur. Now the only way to rectify matters is *control over the manufacture*, and an insistence that the quality of the material of the prepared food shall

* Reports on Public Health of Finsbury, 1903, p. 73; Ibid, 1904, pp. 93 and 96.

be good, the manner of its preparation good, and the premises where it is made sanitary. Nothing short of this will suffice. We control by law bakehouses, margarine factories, ice-cream premises, and all meat shops. We should do the same wherever food is prepared for sale. In Finsbury we have attempted something in this direction, and between 1900-1905, we seized a large quantity of unsound raw material about to be made into prepared foods, and in fourteen cases we prosecuted, obtaining £383 8s. in fines and costs. Three of the defendants also were sent to prison. But much remains to be done, especially in the control of imported tinned food, which should come under equally strict inspection as home-produced food, and should be marked with the name and address of the manufacturer and the date and place of canning. The purchaser would then know what he was buying. Much may be hoped for from the new legislation proposed by Mr. John Burns, M.P., (Public Health Regulations as to Food Bill), and now before Parliament. Briefly what is wanted in respect of food-control is :—

1. Protection of the consumer.

2. Equal treatment and a fair measure of uniform administration for the whole meat and food trade throughout the kingdom.

3. Control over foreign imported meat.

In order to obtain this protection it is necessary to create a well-informed public opinion which shall be sufficiently strong to carry legislation in opposition to vested interests.

CHAPTER IV.

THE PROBLEM OF THE MILK SUPPLY.

"The crux of the question lies in the steps that should be taken to bring an adequate supply of pure milk within reach of the poorer classes."—*Report of Interdepartmental Committee on Physical Deterioration.* 1904, Vol. I., p. 54.

THE problem of the milk supply has mainly arisen because of the growth of the towns and because of the increase in our knowledge of milk. The last century witnessed a change in the distribution of the ever increasing population which we know of as the growth of the towns. A century ago (1801) the total population of England and Wales was 8,892,536 of whom 1,486,017 or 16.7 per cent. lived in towns of over 20,000 persons. To-day (1907) the population of England and Wales is 34,547,016, of whom 20,653,766 live in towns of over 20,000 persons. This gives 59·7 per cent. of the population living in towns now as against 16.7 in 1801, or a rise of 43 per cent. In 1801 there were five "great towns" having a population of more than 50,000 and eight "smaller towns" with a population between 20,000 and 50,000, making thirteen towns in all. To-day there are 76 great towns and 142 smaller towns, or 218

in all. This change in the life of the people lies at the root of many social questions now demanding solution. It concerns, of course, the housing question, overcrowding, means of transit, local government, and poverty. It concerns also the milk question. The milk market is now larger and is far removed from the source of supply. What sufficed for our forefathers will not now suffice for us, not because our physical needs have changed, but because the conditions of our social life are different. In the past the consumer lived near the cow, could exercise some sort of indirect control over the dairying and received his milk within a short time of milking. Now all that is changed. The milk is obtained outside the control of the consumer, has often travelled by rail, and is twelve to twenty-four hours old before he receives it.

So the problem is partly a social one. But we also know more about milk now than formerly, and this likewise has affected the question. For instance, we know that unclean milk can produce disease in children consuming it, that infected milk can be the cause of scarlet fever, typhoid fever, and diphtheria, and that milk from a tuberculous cow can produce tuberculosis in man. Further, the new kind of market for milk has led to various kinds of adulteration. The milk problem therefore has now come to be this : How to deliver in our towns, at a low price, a clean, wholesome milk, unadulterated and free from all infection, of high quality and sufficient in quantity.

The Quality of Milk (its Chemistry and Bacteriology).

Milk is a fluid secreted by the mammary gland. It consists of *water* (86-88 per cent. of it), *milk fat*,

which constitutes 3½ per cent. of the milk, occurs as suspended globules, and may be skimmed off or separated as "cream," *milk-sugar*, *proteids*, or the nitrogen constituents, the chief of which is casein, and certain *chemical salts*, phosphates and lime being present in the largest amount. Human milk contains less fat, less proteid, and more sugar than cow's milk, and therefore to make cow's milk as much like human milk as possible, it is necessary to add a little water and some milk sugar (lactose). If we leave a bottle of good milk to stand for some days it will separate out, the fat rises as cream, the casein falls as curd, and between them is the clear water or milk serum. By churning, as everyone knows, the cream becomes butter.*

Now, whilst these are the normal constituents of milk it must be remembered that a certain amount of fraud is perpetrated in respect of milk, addition of water and removal of cream being the most frequent; various kinds of preservatives may be added to "keep" the milk; skimmed and separated milk is "fortified" by addition of condensed milk; and a good deal of careful mixing and manipulation goes on. So that, though people do not often get the proverbial "chalk and water," they very often get an inferior article. The Local Government Board once estimated that London paid £30,000 a year for water added to its milk! In its latest report (1905) it is recorded that 10 per cent. of all market milk tested was found to be adulterated.

But milk usually contains something more important than adulterants, and that is *dirt*. In the cow shed at the farm, in transit on the railway and

* See also *Food and Dietetics* (Hutchison), pp. 107-141.

cart, in the milk shop, and in the home of the consumer it becomes contaminated with dust and particles of hay, manure, and dirt of every description. This is unpleasant but it is not the worst part. *Dust carries microbes with it.* So it comes about that milk, which leaves the healthy udder of the cow a pure and sterile fluid, may become an extremely dirty fluid long before it reaches the consumer. Dirty cows, dirty cowsheds, dirty milkmen, dirty cans, all contribute their share of filth, and milk being an exceedingly favourable nidus for the rapid growth of microbes, thus becomes heavily polluted. Nor must we forget that disease of the cow or of the milkman will still further imperil the quality of the milk. There are four chief groups of microbes or bacteria found in milk.

1. Ordinary bacteria of soil and water, etc.
2. The bacteria of milk fermentation.
3. Intestinal bacteria from manure, etc.
4. Disease-producing germs.

These various micro-organisms gain access to the milk at the farm or between the farm and the consumer. The first two groups may produce an inferior quality of milk, the last two give milk the power to produce disease in persons consuming it. The number of microbes present in milk varies enormously, and is dependent upon the cleanliness or otherwise of the dairying. The standard of measurement used is the same as in water, namely, the cubic centimetre (20 " drops "), and we may have a clean milk containing only a few hundred micro-organisms per c.c. or a dirty milk with several millions per c.c. The enormous number of bacteria recorded as found in milk appeals to the imagination, but it is important to remember

that such figures are of relative importance only. They are not necessarily injurious of themselves, unless, indeed, they be disease-producers. They are of importance as an indication of contamination and bad dairying.

The Effect of Time and Temperature upon Milk.

Milk as ordinarily placed on the market then contains many bacteria, and the two factors which chiefly affect the active operations of these microbes are the lapse of time and the conditions of temperature. Here, for example, are some figures of a milk tested by Freudenreich, and which was kept in a cool room: Immediately after milking it contained 27,000 micro-organisms per c.c.; after four hours, 34,000; after nine hours, 100,000; and after twenty-four hours standing, 4,000,000 micro-organisms per c.c. In a warm room another milk gave 153,000 at the beginning and 85,000,000 per c.c. at the end of twenty-four hours. Dr. Park, of New York, has made a number of investigations into this subject and has shown that the increase in numbers, as we should expect, depends upon the quality of the milk itself. In a good supply the increase is not so great or so rapid as in a dirty supply from a poor and unclean shop. From these simple facts it is clear that milk is a very favourable nidus for microbes to multiply in, and they increase vastly more than they would in water. This is the reason why water "keeps" better than milk. For the multiplication and rapid increase of certain species of milk organisms is in point of fact the cause of milk turning sour—or in other words undergoing acid fermentation. *All natural souring of milk is due to bacteria.* The common form of

this souring is lactic acid fermentation, by which the milk sugar is fermented by the lactic micro-organisms into lactic acid and other products, and the casein becomes curdled. But there are other forms of fermentation, such as bitter milk, ropiness, soapy milk, and various coloured milks, all due to different species of microbes which set up their changes by the increase in their numbers in stale milk.

But time is only one factor in bringing about these extraordinary changes in milk. The other factor is *temperature.* Micro-organisms multiply most rapidly in warm milk, and least in very cold. In milk at room temperature, for instance, one organism in twenty-four hours may leave a progeny of 150 descendants, but at blood heat it has been shown that it may have a progeny of 1,340 descendants. Dr. Park placed some milk which contained 3,000 organisms per c.c. at a freezing temperature (32° F), at room temperature (60° F), and about blood heat (94° F), with the result that in twenty-four hours the bacteria in the first sample had not increased at all, indeed had declined, many of the microbes being unable to survive the coldness. There were 2,400 per c.c. But at the end of the twenty-four hours the second sample (60° F) had 450,000 bacteria per c.c., and the third sample, which had been kept for the twenty-four hours almost at blood heat, contained the vast number of 25,000 million bacteria per c.c. The writer has made many similar experiments, all of which go to prove the same fact, namely, that warm temperature favours the rapid growth of bacteria in milk. Nor is this all. For Professor Delépine of Manchester has shown that milk kept for a long time at a warm temperature is also

more poisonous to animals than a new milk kept at a low temperature. He states that "what is produced in a few hours in summer may also occur in winter when the milk has been kept a long time."*

It is evident from these facts that to keep milk good we must, as a rule, not keep it too long and *we must always keep it cool.* Milk should invariably be cooled immediately after milking.

The Disease Producing Power of Milk.

There are three groups of disease which have been attributed to milk, namely, the infectious diseases, tuberculosis, and epidemic diarrhœa in children.

The *infectious diseases* communicated by milk are typhoid fever, diphtheria, scarlet fever and sore throat. Dr. Michael Taylor, of Penrith, was one of the first to demonstrate the conveyance of *Typhoid or Enteric fever* by means of milk. This was in 1857, and since that date nearly 200 epidemics of this disease have been traced to an infected milk supply. Indeed, it has been estimated that seventeen per cent. of all typhoid outbreaks are due to milk-borne infection. The common channels by which the typhoid virus gains access to milk are by personal contact with typhoid patients (as at Penrith, 1857), by infection from washing milk vessels with infected water (Clifton, 1897), by adding infected water to milk (Moseley, 1873), by infection from the air from dried typhoid excreta (Millbrook, 1880), by infection from contaminated cloths or clothes (Barrowford, 1876), or by infection derived from water in which milk in vessels was being cooled

* For fuller account as to bacteria in milk see *Bacteriology and Public Health* (pp. 178-252) and *Bacteriology of Milk*, by Swithinbank and Newman (Murray), 1903.

(Springfield, U.S.A., 1892). Since 1867, when Dr. Taylor showed that *Scarlet Fever* might also be spread by milk, more than seventy epidemics of this disease have been traced to this channel of infection. It is held by some that scarlet fever is a disease of cows, and it is possible that this is a source of milk infection. More commonly, however, the milk becomes infected from human sources. *Diphtheria* too, in 1878, was shown by Dr. W. H. Power, now Chief Medical Officer of the Local Government Board, to be conveyed by milk in an epidemic in North London, and since that date about forty outbreaks of this disease have been traced to milk infection. Lastly, there has been a large number of *Sore Throat* outbreaks, undoubtedly conveyed by milk. Sometimes the symptoms in such epidemics are similar to those of Scarlet Fever, and further, it has been shown repeatedly that such milk, able to produce these conditions, has been derived from cows with inflamed udders. A marked instance of this occurred in 1902 at Woking, where ninety-eight different households were attacked, the milk being obtained from two cows suffering from *mammitis*.*

In a general way it may be said that the characteristics of milk-borne disease are the following: *Milk infection follows the milk cart,* that is to say the incidence of milk-borne disease falls on those who have drunk milk. Women and children are affected more than men, and better-class households more than the very poor, who drink little or no milk. Milk-borne disease will occur in certain houses and certain streets served by a particular milkman. Again, more than one case will probably

* For particulars as to milk borne diseases see *Bacteriology of Milk* (pp. 210-391).

occur in a family and the multiple cases will begin at the same time. The incubation period is short, the onset sudden, and the decline rapidly follows the stoppage of the milk. And lastly, it has been found that infectious diseases spread by milk are generally mild and there is a low mortality.

Tuberculosis will be considered in a subsequent chapter. Epidemic Diarrhœa becomes most prevalent and most fatal in the third or summer quarter of the year, particularly in dry hot summers. Further, we shall find that it mainly attacks infants living in towns, especially infants which are not breast-fed, and chiefly those in the middle of their first year of life, that is to say at the period of weaning, *when they first begin to take cow's milk.* In short, there is now overwhelming evidence to show that epidemic diarrhœa is mainly due to the domestic infection of milk and other articles, the infection being derived from filth or from previous cases. It is probable that such infection is often carried by flies.

The Consumption of Milk.

And now lastly a word may be said upon the average quantity of milk consumed. Let us clearly recognise that the importance of this milk problem depends not only on the spread of disease by milk nor the injury done to infants by the consumption of dirty milk, it is important also from the point of view of the *under-feeding of children.* It has been calculated that the daily consumption of milk per head of the population in this country is less than half-a-pint (about twenty gallons a year). In Finsbury we have found it to be even less than that, working out at

between one-fifth and one-quarter of a pint, and among the poor the average is from one to two ounces per day. This is not sufficient. Milk is the ideal food for children, and a most important auxiliary food for adults. It has been held, and rightly so, that if we could only supply the hungry children of the elementary schools with a daily quantity of milk we should do something substantial to mend the physical degeneration of the race. It is not too much to say that to improve and *increase* the milk trade is a requirement of national importance, if for no other reason than the return value we should obtain in extra nourishment gained.

When we think it over it is marvellous that we allow a great industry like dairying, and one which might be of the highest value to the well-being of our people, might, if properly grappled with, solve many of the problems of our depressed agriculture, and take thousands of people back to the land, we allow it to pass out of our hands for the lack of a little co-operation and a common-sense administrative control. We accept, instead, an importation of 20,000 cwt. of condensed milk every week, and a total dairy import for which we pay £32,000,000 per annum !

The Control and Protection of Milk.

The various facts we have now considered guide us as to the means of control of one of the most important food industries. It is evident that the solution of the problem is partly social and partly scientific. But it should also be remembered that the control of milk is an excellent instance of the necessity of co-partnership between the producer and the consumer. Good clean milk is in fact not

obtainable except by such means, for although the milk purveyor may produce a first-rate milk at the outset, much depends upon the treatment the milk receives in the home as to whether or not the consumer really secures the highest results. For convenience in considering the various means of protection we may think of them under four headings :—

1. *Control by the Consumer.* In more senses than one the "trump card," so to speak, is in the hand of the consumer. He pays the piper and so he may call for the tune. The milk seller will at once respond to the requirements of his customer. If people insist on having a clean milk there is no doubt at all they can get it. But there are at least two other ways in which the consumer controls his own milk supply. First, milk in the home must be kept clean and cool. A clean milk vessel, protected by some sort of cover from dust, and stored in a cool place is an absolute necessity if milk is to be kept sweet. Vessels used for milk should be frequently cleansed, a few drops of stale or sour milk at the bottom of a jug being quite sufficient to turn sour any fresh milk poured into the jug. Secondly, milk of doubtful quality can always be made safe by boiling. Bad milk can never be made good by boiling, but it can be made *safe*, for five minutes' boiling will kill all or any disease germs. Therefore, in times of epidemic, or when in doubt, *boil your milk.* The harm caused to children by drinking boiled milk has been greatly exaggerated. In any case it only concerns young children fed exclusively on sterilised milk.*

* To boil milk in such a way as to avoid the boiled taste use an ordinary double saucepan ; place the milk in the

2. *Control by Communal Enterprise.* In various cities in America and elsewhere much has been done to improve the milk supply by Medical Commissions, which have laid down certain standards which milk of high quality should reach and have granted certificates to the sellers of such milk. This, of course, has led the public to prefer the certificated milk over that which did not reach the standard. The same sort of effect has been produced by some of the great dairy companies in Denmark, and by municipal control and certification of milk.

3. *Control by the Dairy Trade.* The importance of commencing the control of milk at the beginning cannot be over-estimated, and if the dairy trade intend to hold the confidence of the public they must begin at the beginning. Milking herds, their breeding, feeding and management, call for much more attention than they have yet received in this country. To produce good milk should be not only a trade but a science. Cows must be properly kept, regularly watched and cleaned; cowsheds must be maintained in a cleanly and sanitary manner; and the process of milking must be effectually carried out. Thorough cleanliness must take the place of the slackness, filth, and mismanagement which now abound in most farms all over England. A model dairy does not require a large outlay of capital so much as keen intelligence and unremitting care. The dairyman's creed should consist of three articles: First, prevent microbes and dirt gaining access to the

inner vessel; let the water in the outer one be cold when placed on the fire, bring the water up to boiling point and keep it boiling for five minutes without removing the lid of the inner pan.

milk by cleanly methods of dairying; secondly, strain the milk thoroughly to screen off accidental pollution; and thirdly, prevent by refrigeration the growth of microbes introduced by such accidental pollution. Bacteria will not increase in refrigerated milk. So we may sum up the creed in a sentence: *clean milking, careful straining,* and *immediate cooling.*

But that is not the end of the responsibility of the trade. They must co-operate in demanding from the railway companies a good milk service. Reform of railway transit of milk will come from an organised trade able to be a good customer. The companies cannot furnish an efficient and express service for a few churns or an odd waggon here and there. What is required is the co-operation of farmers and milk producers of a district for the carrying on not of a casual business from many centres but a well-organised trade from a few centres and by efficient dairying to raise the quantity and quality of milk per district. When that is available the railway companies may fairly be called upon to fulfil the three cardinal requirements of a good milk service, namely, a cleanly and rapid service in refrigerator cars.

Nor is that all. The dairy trade has yet to learn cleanliness and efficiency in its retail business. Milk is still sold as a rule, from open uncovered milk pans in dirty little general shops, where one buys everything, including spices, herrings, soap, fire-wood, paraffin oil, and blacking! This does not give milk a chance. It may have been sent from the farm in good condition by a rapid train service, but in the shop of the retail vendor it is exposed to every kind of chance contamination, including milk cans of doubtful cleanliness, the

flavour of haddock, and the dust of the street. What is needed here also is cleanliness and protection both from dirt and infection.

4. *Control by the Law.* Milk law in England is in need of reform. The Dairy, Cow-sheds and Milk-shops Order is twenty-three years old. The law has been improved in respect to workshops, bakehouses, margarine factories, ice-cream-making premises and meat shops, but milk is still allowed to be purveyed under extraordinary conditions. What should be required by the law is (1) regular veterinary and medical inspection of all cows yielding milk for human consumption; (2), thorough sanitation and cleanliness in cowsheds and dairies, to be enforced more by central authority than as at present; (3) the annual licensing of all milk sellers, such licence to be withdrawn if the premises are kept in an insanitary or unclean condition; (4) that the responsibility as to structural conditions of dairies or cowsheds should be placed on the owner; and (5) that to sell unclean milk, infected milk, or milk to which preservatives have been added, should be as illegal as to sell adulterated milk. These and many other reforms could be obtained with comparatively slight amendment of the law, and indeed the entire problem would assume very different proportions if the present Dairy Order was properly and uniformly enforced instead of being allowed to remain almost a dead letter.

CHAPTER V.

THE NECESSITY OF FRESH AIR.

"I would speak in especial of a chamber which I once entered, as I had often before entered it, early one winter's morn. It was the sleeping closet of my son. His low trestle bed stood betwixt the severally widely open window and door, while the keen but exquisitely fresh sweet atmosphere from windswept hills careered through the apartment ceaselessly. The hue of exuberant health mantled over the boy's every feature, while bordering the margin of the coverlet there extended a fringe of pure white snow which the genius of the fragrant night had wafted in, all harmlessly, during the hours of my child's repose."—Spoken of the late Sir WILLIAM MACCORMAC, President of the Royal College of Surgeons of England.

"The mistake of most modern ventilation is that there is not enough of it."—*The Treatment of Phthisis*, ARTHUR RANSOME, M.D., F.R.S.

THE breathing of fresh air is essential to healthy life. We all know that the circulating blood in the human body is the means by which food (proteins, sugar, starch, fat, etc.) and oxygen are carried to the tissues and organs of all parts of the body. The food is picked up by the blood from the digestive system, the oxygen is picked up in

the lungs from the air which we breathe. The flesh and organs of the body use up this oxygen which is thus brought to them by the blood, and empty back into the blood, so to speak, their own waste products. The blood therefore not only brings oxygen to the tissues but carries away some of the waste materials which it gets rid of in the lungs. The lungs are thus the great centre of exchange. It is in the air cells of the lungs that the blood is brought into direct contact with the air which has been breathed in. It is there that it gives up its burden of waste products (carbonic acid gas, water, organic matter, ammonia, etc.) and takes in its new quantities of oxygen. If it cannot make this exchange the blood becomes impure and of poor quality, and the whole body suffers in consequence.

It is upon this simple principle of physiology that the need of fresh air, and therefore of ventilation, is based. To understand the elements of this subject it is necessary to consider what is the usual composition of the atmosphere, its effects on health, what are its physical properties, and then finally what are the principles and means of ventilation.

The Composition of the Atmosphere.

Fresh air is a mixture of certain gases, some water, and a small amount of solid matter in the form of very fine particles. Its chief gas in amount is nitrogen, an invisible, tasteless, odourless gas, which from the point of view of public health is important only as a diluent of the air. By far the most important gas present is oxygen, which is also a colourless, tasteless gas, which burns up any organic matter exposed to it. It is increased in quantity by vegetation and by

rain, but decreased by respiration of man and animals, by combustion (the burning of fires and lights), by organic effluvia, and by fog. The average quantity present in air is twenty-one per cent. Then, thirdly, there is carbonic acid gas or CO_2 (about .04 per cent.) which differs from the other two in being poisonous if breathed in large amounts. This gas is also increased in confined spaces by respiration, combustion, decomposition, and fog, and it is diminished by vegetation, which absorbs it, by rain, by high winds, and of course, by ventilation. There is more in town atmosphere than in the country and more still in " close " rooms and tunnels. Ammonia is also present in air, and marsh gas (in mines) and compounds of sulphur (from stoves and putrefaction). From what has been said it will be understood that air expired in human respiration is less pure than the ordinary fresh air, because it contains some of the waste products of the body. It will, therefore be convenient to state the broad differences between fresh and expired air in a table :—

	PERCENTAGES.	
	Fresh Air.	Expired Air.
Oxygen	21	17
Nitrogen	78	79
CO_2	0.04	4

It should be added that expired air as well as containing less oxygen and very much more CO_2, also contains more organic matter and more water than fresh air. The burning of fires, gas and candles also makes fresh air less pure, for the CO_2 and sulphur are both increased, and fine particles of carbon are also added. It may be noted that

a single gas burner spoils as much air as two men. It is these changes which constitute the injury to the atmosphere of a smoke nuisance. Decomposition of animal or vegetable matter and dust also pollute the air.

Further, the atmosphere contains a good deal of solid matter as fine particles. These consist of organic or inorganic dust, carbon particles, bacteria, and so forth. Their origin is due to dirt in towns, to uncleanliness in houses, to trade processes, and to the various pollutions to which reference has been made. Such particulate pollution depends also upon dryness of the air and absence of rain, upon gravity, upon season and air-currents, and upon the general surroundings of town or country.* The atmosphere of towns and of stuffy rooms and ill-ventilated workshops is more contaminated in every way than sea air or fresh country air. The usual index of polluted atmosphere is the degree of carbonic acid present.

Some Physical Properties of Air.

Before we consider what can be done to provide fresh air in the home and the workshop it is necessary to remember some of the physical properties of air. Three of them may be stated thus :—

1. Air can be *compressed* by pressure.
2. It can be *expanded* by heat.
3. It can be *diffused* by both pressure and heat.

The volume of air in any given space depends upon the two forces of pressure and of temperature. Indeed, under extreme pressure at a very low temperature, far below freezing, Professor Dewar has

* See *Bacteriology and Public Health* (Newman), 1904, pp. 73-91.

shown that air can be liquefied. The opposite of compression is also true, air can expand, like other gases, when heated. These forces affect the density of the air, and according to its density it diffuses from one room to another. Now it is upon these three broad facts that ventilation depends. We can force more air into a closed room by pressure, we can expand it by lighting a fire, and we can diffuse it by both forces acting on its density. As cold air has a heavier weight than warm air, it falls and the warm air rises. When we open windows we lower the density in the room, and air, particularly the warm air at the top, escapes. It is thus that we obtain ventilation, or a control of air currents, for that is what ventilation means.

The object of ventilation is to purify the air of houses, workshops, and buildings which have become vitiated by (1) respiration and exhalation of man and animals ; (2) the burning of coal, wood, gas, candles, lamps, etc. ; (3) decomposition of animal or vegetable substances ; (4) pollutions from various trade processes ; and (5) household dust and dirt.

The Principles and Methods of Ventilation.

There are, in principle, two chief means of ventilation. The first is what is termed *natural*, and depends on the character of the inside and outside air currents, the second is known as *artificial*, and depends on some artifice by which air is propelled into a room or extracted. It is important to remember that the necessity for, and means of, ventilation depend not only upon the chemical composition of air or its physical properties, but other circumstances also. Four of these may be mentioned.

First, *ventilation depends upon the cubic capacity of the room.** It is clear that if one man occupies a very large room containing fresh air it will be unnecessary to change the air of that room for a considerable period of time, it will take a long time, so to speak, for him to breathe it. On the other hand a family of five persons, living in one small room, will very quickly use up the contained air. These are extremes, but they illustrate the relation of cubic capacity to ventilation. If the cubic capacity be large, frequent ventilation is less required than if it be small. The ordinary minimum standards in this country are 300 cubic feet of space per head for sleeping purposes only, and 400 for sleeping and living purposes; in hospitals 2,000, in factories 250 (400 during overtime), in underground bakehouses 500, in schools 120, and in canal boats 60 cubic feet. It is important to bear in mind that air space is chiefly valuable as making ventilation possible without "draught," and not as a store of fresh air

Secondly, *ventilation depends upon the standard of air pollution.* We have already seen that fresh air contains 0.4 per 1,000 parts of CO_2. Now it has been decided after scientific inquiry that 0.6 parts shall be considered as a permissible degree of impurity. We must therefore aim to introduce a sufficient supply of fresh air into a room to keep the CO_2 at or below this point. An average man gives off 0.6 cubic feet of CO_2 per hour. From these figures it is calculated that the necessary amount

* This is obtained by measuring the height, length, and breadth of the room, and multiplying up; *e.g.*, if a room have dimensions of H. 10, L. 30 and B. 20 feet, the cubic capacity is 6,000 cubic feet.

of fresh air to be provided is 3,000 cubic feet per head per hour. So that if a room have a capacity of 3,000 cubic feet, it is necessary to change the air once an hour for each person, if it have a capacity of 1,000 c.f. three times per hour for each person, and so on. Such a change as this ought to keep the CO_2 well within bounds, and it ought not to exceed in any event more than one part per 1,000 (that is allowing an addition of 0.4 to 0.6, which is the standard). But sometimes it rises to 3, 4 and even more parts per 1,000.

Thirdly, *ventilation depends on the condition of the external air*, for if that be used up and stale, one cannot get the same quantity of oxygen into a room except by much more frequent ventilation than would be necessary with clean fresh air. Natural ventilation is, therefore, more difficult in foggy weather than in clear, and in the centre of a city than in the country. External air is purified in its turn by diffusion and winds, by rain and sunlight, and by vegetation, which absorbs CO_2 yielding oxygen in exchange.

Lastly, the success of *ventilation depends upon cleanliness and absence of overcrowding*. It is evident that a dirty, dusty room is less readily ventilated than a clean room. And the same applies to overcrowding of persons in the rooms. These are two of the common means of air-pollution, and when they occur they make the exchange of the air more difficult and less effectual.

The actual means taken to secure ventilation are of two kinds, natural and artificial.

Natural ventilation means the use of such openings in a room as will permit fresh air to enter and exhausted air to escape. The forces operating in such entrance and escape are local air currents derived,

as a rule, from conditions of temperature and pressure, and the means of entrance and escape are doors, windows, chimneys, perforated bricks, valves, louvred window panes, Tobin tubes, gratings, etc. There are two points to remember in the practice of natural ventilation. The first is that, as a rule, cold air should be admitted near the floor, or where it can be warmed by passing in near the fire or over hot pipes, and the second is that ventilation to be effectual must be *through*, that is, ventilation should not be all on one side of the room or house.

Artificial ventilation is worked on the principle of creating a *plenum* (or fulness of air) or a *vacuum* (emptiness of air) in the building to be ventilated. That is to say air may be propelled into or extracted from the building. The former is achieved by revolving fans or other motor contrivances; the latter is brought about by fans or heated outlet shafts. Ordinary fire-places, chimneys, and extraction shafts are all of this character, and many public buildings, mines, and steamers are thus ventilated. An excellent example is the ventilation of the Houses of Parliament, which is obtained by using the clock tower as an extraction shaft, at the bottom of which is a furnace; so that air escapes in large volumes, and its place is taken by incoming air by which a current is created through the whole building.

The Fresh Air Problem.

The importance of fresh air to the human body can hardly be exaggerated. It is, as we have seen, that from which the blood gains half its value. Further, an understanding of its importance does not lessen the more one studies the evils arising from its absence, in ill-ventilated places. These are of three kinds. First, there is the inevitable result of *poor and impure blood* which secures no exchange in the lungs of a person breathing exhausted air.

The result is a lack of fresh oxygen and therefore of nutrition to the body generally. Many of the workers in sedentary employments suffer in this way. Secondly, there are *various forms of lung diseases* such as consumption and coal miner's lung. Tuberculosis attacks in a special degree the lungs of persons not breathing expansively enough and not inhaling fresh air, and is a disease which has responded to improved ventilation. Coal miner's lung is but an example of many lung diseases due to the inhalation of particles of dust of one kind or another. Then thirdly, absence of ventilation promotes *the transmission of infection.* The virus of certain diseases, as for example, small pox and most of the common infectious diseases, travels through the air and is less diffused and therefore more harmful in ill-ventilated rooms. Badly ventilated dwellings indeed, are among the ordinary means of such infection, readily spreading from person to person, for the contagious particles which are given off have but little chance of escape and are likely to be inhaled by somebody else. "The risks of contagion through the air," wrote Dr. Vivian Poore, "are diminished in proportion to the thoroughness of ventilation."*

Ventilation in the proper sense, that is supply of fresh air as distinguished from mere air space, is therefore of the greatest importance if we would avoid sowing the seeds of disease broadcast in a favourable soil. The degree of CO_2 present is now usually taken as a convenient index of pollution, because it is found that deoxidised, exhausted, and contaminated air contains it in high proportion. We have already seen that the amount of CO_2 present in fresh air is 0.04 per cent., or, expressed

* *Essays on Rural Hygiene*, 1903, p. 230.

in the usual form, four parts per 10,000 of air. Usually it is somewhat less. Taking that as standard of fresh air it has been held that indoor air of workshops should on no account exceed twelve parts per 10,000, and any excess of that amount operates injuriously. Haldane and Osborn, in carrying out investigations for the Home Office, found that the amount of CO_2 in the air of workshops where workers were employed often exceeded this standard. In bookbinding workrooms it varied from 3.5 to 25.7 parts per 10,000 ; in cotton factories from 13.3 to 38.6 ; in textile factories from 3.2 to 47.0 ; in tailoring workshops from 3.2 to 53.2 parts ; and in cotton spinning rooms from 3.5 to 56.6 parts of CO_2 per 10,000. In tailoring and other industries under Jewish control, the air was much fresher than in similar industries under English control.* In Finsbury we have made investigations with very similar results. The atmosphere in all kinds of workshops, yielded amounts of CO_2, varying from six parts to forty-eight parts per 10,000.†

These returns leave us in no uncertainty as to the wide prevalence of atmospheres in factories and workshops, which are so stagnant, stuffy and filthy that they cannot fail to exert an injurious influence on the workers. There is, therefore, great need for education of public opinion, regarding this matter. Nor is it in workshops alone that the need exists. Homes and especially bedrooms, where people spend one third of their lives, require even more perhaps than factories, abundant and suitable ventilation, especially if the room be small or

* Report of Departmental Committee on Ventilation of Factories and Workshops, 1902.

† Report on Public Health of Finsbury, 1904, pp. 200-209.

occupied by more than one person. Probably less than 5 per cent. of the population ventilate their homes as much as the demands of health require.

The fresh air problem is, therefore, one of personal hygiene, combined with public provision of the means whereby a pure atmosphere may be obtained, namely, the prevention of black smoke and other air pollution nuisances, and the provision of open spaces in towns.

Our individual moral responsibilities with regard to the air we breathe are great. Our first duty is not to befoul the air more than we can help, to keep all about us clean and pure, inside our houses and rooms free from dust, and outside not to allow the accumulation of refuse. Our next duty is to see that a proper supply of fresh air is admitted to our dwellings, and especially our bedrooms and workshops, where two-thirds of our lives are passed, all too frequently in a smelling, frowsy atmosphere. Both employers and employed should remember that there can be no doubt of the economy of giving an ample supply of fresh air, for more and better work will be done, it will be performed more cheerfully, and it will be more healthy and comfortable for all concerned.

CHAPTER VI.

THE CAUSE AND PREVENTION OF INFECTIVE DISEASES.

"When man learnt how to protect himself from the wild beasts he made the first step in civilisation. To-day man is learning how to defend himself from the microbes—it is a step of equal importance. A day will come when in Berlin, in London, in Paris, man will not die of diphtheria, of typhoid, of scarlet fever, of cholera, of tuberculosis, any more than he dies in these cities to-day from the venom of snakes or the tooth of wolves."—FRANKLAND'S *Pasteur*, p. 129.

WE have already seen that it was a linen draper in Holland who, in 1632, first demonstrated the existence of microbes. These germs or bacteria were shown by primitive microscopes to occur in water, and other fluids, but they were not thought to be anything more than accidental. It was Plenciz of Vienna who, in the middle of the eighteenth century, first conceived the idea that they were almost universal in nature and probably the cause of decomposition, and it was just a century later that, by a series of important discoveries, it was established beyond dispute that some of these micro-organisms were able to bring about fermentation, putrefaction, and even disease.

An Italian named Spallanzani, the famous French chemist Pasteur, and John Tyndall of England, were three of the workers who first proved this to be true. They showed that the atmosphere contained unseen germs of life which, when they gain access to organic infusions, set up fermentation. Quickly following in their footsteps came Davaine, Pollender, and others, who found in the blood of animals suffering from certain diseases particular forms of micro-organism, which when introduced into other animals set up the original diseases again. The wonderful history of the growth of man's knowledge of these invisible forms of life and the enormous part they play in human life and death, may be summarised in three periods by saying that, in the seventeenth century, these living moving organisms were first detected; in the eighteenth they were found to be the cause of fermentation; and in the nineteenth the producers of disease. During the last twenty or thirty years immense strides in our knowledge have been made, and we are now able to say that anthrax, tuberculosis, leprosy, plague, cholera, typhoid fever, diphtheria, tetanus (lock jaw) and a few other less important diseases are certainly due to infection with bacteria, and only a little less certain are we of the cause of scarlet fever, pneumonia, and small pox. As far as we know disease breeds true, and these diseases are not contracted except by infection with the particular germs which cause them.

The Germ Theory of Disease.

Now in the production of infective disease, that is to say, of those diseases which are produced by particular bacteria, there are two factors to consider. First, there is the infecting micro-organism, and

secondly, there is the person infected. We may think of the first as the *seed* and the second as the *soil.* And we must now turn to give some thought to each.

We are as yet far from a complete knowledge of bacteria, and so it is not possible at present to say many certain things about them. We know, however, that they are among the lowest and simplest forms of life upon the earth, that they are so small that they are quite invisible to the naked eye, and that they exist almost everywhere. We know too, that they are more vegetable than animal, that they are first cousins to the Moulds on the one hand and the Yeasts on the other, and that they possess powers of movement. They increase by dividing, or by producing spores even smaller than themselves. There are three chief forms, namely, the round form (*micrococcus*), the rod-like form (*bacillus*), and the thread-like form (*spirillum*). Above these, as a little higher form of life, are a group of micro-organisms which have branches and something in the nature of seeds. Most bacteria are "harmless" that is to say, they do not cause disease. They are all, however, concerned in some way in the economy of Nature, living either on dead organic matter (*saprophytes*), or at the expense of some other organism (*parasites*). As a general rule, and speaking relatively, the saprophytes contribute most to the benefit of man, and the parasites do the reverse. The more we learn about bacteria the more we recognise that they are agents of good or ill no longer to be ignored, and that the evolution of biology, as represented in these unseen hosts, is coming to occupy a new place in the minds of men, as part of the general social evolution which is taking place. For micro-organisms play a great

part in man's life. They occur in our drinking water, in our milk supply, in the air we breathe. They ripen cream, and flavour butter and cheese. They purify sewage, and remove waste products from the land. They break down organic matter, and also make it available for other forms of life. They are the active agents in a dozen industrial fermentations. They produce disease and are the main cause of death on this planet.

There is an interesting question concerning bacteria and disease which will occur to the reader. How do bacteria produce disease? For a long time scientific men believed that these micro-organisms, so to speak, "devoured the tissues" of the human body, attacking it in the same sort of way as larger parasites. But we now know that bacterial action is not of that character. It works in a two-fold manner. In the first place, the bacteria themselves may cause disease, their presence in vast numbers setting up inflammation of the tissues affected. In the second place bacteria act by producing poisonous bodies, or *toxins*, in the body of the infected person. Between the period of entrance (that is infection) and the appearance of the symptoms, we have an "incubation period," during which time the germs are multiplying and producing sufficient toxin to result in symptoms of disease. For example, a man drinks some typhoid polluted water. For ten or fourteen days the bacilli are making headway in his body without his being aware of it. At the end of that incubation period the toxins begin to produce results and we get the signs of disease. Some microbes spread rapidly through the body, producing toxins wherever they go in the blood stream or the lymph. Others remain at the point of

infection and produce their toxins, so to speak, in a local factory, and these, in due course, pass throughout the body. From what has been said it will be understood that the toxins are the chief means of disease production. They act locally and generally, producing local symptoms such as inflammation, and general such as fever. Bacterial infection, therefore, becomes something more than an infection, viz., toxin-poisoning or intoxication.*

The Production of Disease.

But to produce disease, it is necessary to have a favourable soil. If seed fall on stony ground we do not expect fruit. If bacteria infect a healthy and resistant body we do not expect disease. Bacteria are never more than primary causes, for the nature of disease, as Virchow said, *depends upon the behaviour of the organs and tissues with which the bacteria or their products meet.* The normal healthy tissues of the human body *resist* disease, and the healthy blood is no friend to intruding bacteria. Such tissues and such blood contain protective substances (*opsonins*) and protective cells (*phagocytes*). But the body which is depressed in vitality, or injured from previous disease, falls a ready prey to the invading hosts.

It may well be asked, What then are the influences which depress the human body and lay it open to the attack of these unseen foes? The answer is fourfold, and may be stated thus:—

1. Predisposition and heredity.
2. Antecedent disease.
3. Conditions of Environment.
4. Personal habit.

* See *Bacteriology and the Public Health*, pp. 280-324.

We know from experience that a perfect measure of health is only the lot of the few and fortunate. Most men, at some time or other, are attacked by infective disease, and do not simply die of old age. There are a variety of circumstances which predispose the individual to disease, one of the commonest forms of which is heredity. Sometimes there is actual transmission of the virus of disease from parent to child; more frequently it is an hereditary disposition which is handed down. Again, antecedent disease produces a favourable nidus in many cases. Measles, for instance, is often followed by pneumonia or later by tuberculosis; sore throat predisposes to diphtheria, and so on. Then there is insanitary or unhealthy environment such as bad housing, infected water supplies, town life, ill-ventilated workshops, and dirty houses, all of which may diminish the vitality and stamina of people. Lastly, there is the powerful factor of personal habit. Some people eat too much and eat too often, and their overloaded bodies never obtain the rest they require for health; others eat too little and their bodies are under-nourished; yet others eat unwisely, and their bodies are badly nourished; and there are many who maltreat their bodies, and by evil habits and excess, such as alcoholism, weaken their resisting power. Fatigue also acts indirectly in the same way.

Signs and Symptoms of Infectious Disease.

It will be desirable here to mention for purposes of reference the chief signs and symptoms of infectious diseases. The course of such illnesses is usually recorded in four periods: the moment of *infection*, when the infective agent gains access to the body of the individual; the period of *incubation*,

during which the agent is incubating and secreting its toxins; the period of *invasion*, when the virus is producing the chief and specific symptoms of the disease; and *determination*, the result, whether recovery through convalescence, or death. These infectious diseases frequently present themselves in epidemic form.*

Small Pox. Incubation period, 12-14 days; Quarantine, 18 days.

Symptoms: Shivering, rise of temperature, headache, pains in the small of the back, often vomiting. On third or fourth day rash appears as red pimples on forehead, neck, face, and limbs, particularly wrists and ankles. When the rash comes out the patient generally feels better. The pimples enlarge and become vesicles or "pocks," which become pustular about the eighth day, scabbing from the ninth to tenth days, and declining about the twelfth or fourteenth day of the fever, when danger to life is greatest. The disease is highly infectious, but in vaccinated communities chiefly affects adults.

Chicken Pox. Incubation period, 12-14 days. Quarantine, 18 days.

Symptoms: There are no premonitory symptoms as in Small Pox, but the rash comes out first. The pimples begin like Small Pox but are most marked on the face and body, and proportionately less on the limbs. The vesicles do not become pustules, and they appear in successive crops, giving the eruption a more varied appearance than Small Pox.

Measles. Incubation period, 12-14 days. Quarantine, 21 days.

* A disease is *epidemic* when it is widely prevalent over a larger or smaller area; it is *endemic* when it attaches itself, like cholera, more or less permanently to certain localities; and it is *pandemic* when it diffuses itself generally over a great part of the globe.

Symptoms : Sneezing, cold in the head and eyes, rise of temperature and sometimes aching pains and vomiting. The rash appears on the face on the fourth day, is blotchy, irregular and of a purplish red tint, and is distributed over all parts of the body. It begins to fade on the seventh or eighth day, when the fever usually declines suddenly.

Measles is chiefly a disease of childhood, and is very infectious even before the rash comes out. Children having measles should be put to bed as soon as possible and kept warm, otherwise lung complications may supervene.

German Measles. Incubation period, 12-14 days. Quarantine, 21 days.

Symptoms : This is not a serious disease although very infectious. It is similar to measles, but is not preceded by sneezing and catarrh. Sometimes there is sore throat, and thus the disease may at first be mistaken for Scarlet Fever.

Scarlet Fever. Incubation period, 2-6 days. Quarantine, 14 days.

Symptoms: Sore throat, shivering, rise of temperature, vomiting (often apparently the first symptom and mistaken for a bilious attack), hot dry skin. A diffused, uniform, red rash appears on the second day, usually on the chest at first, but spreading all over the body, and disappearing at the end of a week, when peeling begins. This peeling process may last for about a week or for as long a period as four or five weeks. During this time it is important to avoid chill. Some cases are very mild, and although most infectious, may thus escape recognition. A child, sometimes erroneously thought to have recovered, may have a discharge from the ear or nose, or puffiness of the eyelids (dropsy). Such discharges are highly infectious.

Diphtheria. Incubation period, 2-3 days. Quarantine, 28 days.

Symptoms: Sore throat, shivering, headache, rise of temperature, dulness and weakness, greyish-white patches on the back of the throat, foul breath, and swollen glands below the angle of the jaw or in the neck. The kidneys may be affected, and heart-failure and slight paralysis are not uncommon.

Although sometimes a severe disease it may be so mild as to escape recognition. Yet such cases may start an epidemic. Persons apparently quite well may carry the germ in their throats and so act as "carrier" cases. No person who has had diphtheria should be considered free from infection until two bacteriological examinations of the throat have proved negative as regards the presence of the diphtheria-bacillus.

Typhoid (or Enteric) Fever. Incubation period, 7-21 days (usually 12-14), Quarantine, 28 days.

Symptoms: Typhoid Fever may take a number of days to develop. The early symptoms are shivering, rise of temperature, headache, general malaise, and often diarrhœa (somewhat similar to pea-soup). A rose-coloured rash of a few raised spots, like flea-bites, sometimes appears on the abdomen about the third day. The fever declines in the third week, which is usually the dangerous time. No solid food must be given for about five weeks from the commencement of the fever, and during the whole period the patient should be kept constantly lying down.

Typhus Fever. Incubation period, 4-12 days. Quarantine, 28 days.

Symptoms: This rare disease only affects persons living under highly insanitary, over-crowded, and ill-ventilated conditions. It begins with shivering, high fever, headache and delirium. A peculiar dirty-looking mottled rash of a purple tint comes out about the fifth day. The fever lasts a fortnight, during a large part of which the patient may be unconscious.

Mumps. (Parotitis). Incubation period, 14-21 days. Quarantine, 30 days.

Symptoms: Pain and enlargement of the salivary glands in front of the ears, with stiffness of the jaws. A very infectious but rarely dangerous disease.

Whooping Cough (Pertussis). Incubation period, 4-10 days. Quarantine, 21 days.

Symptoms: A disease of young children, not infrequently fatal. Begins with ordinary cough, which in a few days becomes a " whoop " as the breath is drawn in, and then coughing follows in a torrent-like fashion, often until the child is sick. Lung complications are common. The disease is very infectious.*

Methods of Prevention.

The modern methods for preventing the spread of infectious disease are the result of the slow evolution of public health ideas. In the Middle Ages men in the presence of infection betook themselves to religious vows, did penance, or made flight into seclusion. Disease was looked upon as supernatural in origin, and its appearance as a day of visitation. That such methods were not effectual in staying disease is apparent from the records which have come down to us of the ravages of leprosy, plague, and small pox. There was no means of registration, and the occurrence and distribution of disease was unknown except to the afflicted. Nor was it possible to bring any measures forward for general adoption, in a time when the causes and channels of infection were alike unknown. It cannot therefore be matter for surprise that from the twelfth century onwards we have a continual record of the most appalling loss of life and physical suffering from plague and famine.

* For an account of each of these diseases see *Hygiene and Public Health* (Whitelegge and Newman), pp. 328-449; or *A Manual of Infectious Diseases* (Goodall and Washbourn).

Even in the eighteenth century, when the great pestilences had become a thing of the past, small-pox, gaol-fever, scurvy and ague carried off tens of thousands. By these penalties men learn. And as a result of such learning we now have a system of prevention in vogue which, though imperfect in many ways, is, judged by its effects, the means of saving many lives and diminishing much human suffering. It consists of five methods, namely, notification of infectious diseases, isolation of the patient, disinfection, the control of channels of infection, and preventive inoculation.

1.—Notification of Infectious Disease. The first necessity in attempting to prevent the spread of disease is evident. It is to know where the disease exists. Hence there has been established what is known as the system of *notification*, namely, that when certain diseases occur the medical practitioner attending the case, and the head of the family, or in his default, the householder, shall, on becoming aware of the disease, forthwith notify to the Medical Officer of Health of the district in which the house is situated the facts of the case. This duty generally devolves upon the medical attendant, and there are penalties for infringement. The diseases which are notifiable are small-pox, cholera, diphtheria, erysipelas and all the specific fevers (scarlet, typhoid, typhus, relapsing, continued and puerperal). The sanitary authority has powers of extending notification to other diseases in its locality if it thinks desirable, and in this way chicken pox, measles, or "spotted fever" may become notifiable for longer or shorter periods.*

* In London notification is enforced under the Public Health (London) Act, 1891, S. 55, in the country under the Infectious Diseases Notification Extension Act of 1899.

Then in addition to this it is sometimes the practice to arrange for "voluntary notification" of certain diseases, such as consumption or epidemic diarrhœa.

The advantages of notification are obvious. By its means early and complete knowledge of infectious disease and its prevalence and distribution is obtained, with all that it involves in the way of preventing its spread, such as disinfection, isolation, the opportunity of investigation of local and general causes, the exclusion from school of members of infected households, and so on.

2.—Isolation of Cases of Infectious Disease. The next step is the separation of the infected person from the non-infected, either in his own home if that be practicable, or in a special "isolation" hospital for infectious diseases provided by the Sanitary Authority. The latter method is, of course, the more complete. Removal to such a hospital may be enforced by order of a magistrate under certain circumstances, but it is usual to allow some margin for personal wishes. Where suitable and ample accommodation is not available at home, however, it is much the wiser course to consent to removal to hospital.

The advantages of such removal greatly overbalance the disadvantages. There is, of course, the obvious disadvantage of separating the sick person from his relatives and from his home, at a time when he particularly needs both, and this weighs naturally in the mind of patient and friends alike. No one likes such separations. But on the other hand, for the patient or his friends to run unnecessary risks of disease and death is not the most reasonable nor, indeed, the kindest way out of a difficulty. There can be little question that, unless adequate accommodation and good nursing

can be obtained at home without risk to others, it is better, from all points of view, to submit to removal to an isolation hospital. By such isolation the risks to the community and to the family and friends are greatly reduced, the burden of expense and inconvenience in a small home is avoided, and the ordinary work and avocations of the household are but little interfered with. If the hospital be a well appointed one there is also, as a rule, much gain for the patient, who receives nursing and medical attention and skill not usually available in the home.

3.—Disinfection is the killing of the infective agent. Some chemical substances merely arrest the development of germs (*antiseptics*), others only remove the unpleasant smell of decomposition, or shall we say create an alternative smell (*deodorants*) and a third series actually kill the germ (*germicides* or *disinfectants*). It is the germicides then which are used in practice for the killing of the infective agent outside the human body. The house where the patient has been, his clothes, his bedding, his furniture, his books, and everything that is his, needs cleansing or treating with disinfectant in such a way as to remove any danger of other persons contracting infection from contact with infected articles. In practice the Sanitary Authority arranges for disinfection, but as a matter of fact each owner or occupier may disinfect his own premises provided it is done to the satisfaction of the local authority.

Disinfection is carried out in three ways : By using heat, by treating with chemical substances, or by thorough cleansing. Rooms are disinfected, after sealing up, by fumigation with sulphur (3lb. per 1,000 cubic feet of space) or formic aldehyde (thirty

tabloids to 1,000 cubic feet), or they may be treated by spraying or washing the walls, floors, etc., with a suitable disinfectant solution such as formalin, chloride of lime, izal, or carbolic acid. Bedding and clothes are usually disinfected by steam in a steam disinfector, but where this means is not available they may be sprayed, or washed or soaked in disinfectant solution, or they may be fumigated in a cupboard. To disinfect excreta, discharges, and decomposing matter, it is customary to use chloride of lime, potassium permanganate, carbolic acid, corrosive sublimate, lysol, izal, creosol, etc.*

4.—**Control of Channels of Infection.** As soon as the infected person is suitably provided for and isolated from the community the next step in the preventive system is the investigation of the probable channel of infection and, when this is discovered, such control of it as may prevent effectually any further production of disease from the same source. If it is personal contact the removal of infected persons will soon reduce the sphere of evil ; if it is the drinking of bad water or infected milk the water and milk supply must be supervised and in the meantime boiled ; if it is food the infected supply must be stopped, and so on.

Whilst such means are essential at the time of the epidemic, and must on no account be neglected, it is well to remember that to be forewarned is to be forearmed, and that the scientific way to control channels of infection in emergency is to have them under control *before* the emergency. It is idle to lock the stable door when the horse has escaped, or organise a fire brigade when the house is in flames. What we need is such supervision and control of

* *Bacteriology and the Public Health*, pp. 432-451.

housing, water supplies, milk and food supplies, and the timely provision of isolation hospitals, as shall furnish lines of defence ready and equipped for the day of trouble. We English people have been rather slow to recognise this. We glory in the fact that we "muddle through" our crises somehow. He, however, is the wise statesman who, though avoiding unnecessary crises, anticipates and prepares. The same is true in sanitation.

5.—**Preventive Inoculation**. We all know that, in the course of illness, there comes a time when the symptoms vanish, the disease declines and the patient recovers. In past times this was explained by saying that the disease had exhausted itself, having "gone through" the body. It is now known that the explanation of recovery is to be found in the successful resistance of the body, both to the agents of disease and to their products. In other words the toxins, of which we have already spoken, by their action and interaction in the blood and body tissues stimulate, perhaps even produce, some anti-bodies which act as protectors and resisting cells creating a resistance which, in some cases, lasts almost a lifetime. For instance, a person who has had small pox is practically protected for life from another attack, even though he comes within the pale of direct infection. This protection we call *immunity*. It is such immunity also which explains the cases frequently met with in which the human body remains unattacked by disease in spite of its containing the microbes of disease. There is no more interesting chapter in modern science than the record of discovery which has led to our present knowledge of this subject. It is now many years since the famous French investigator Metchnikoff first demonstrated

that certain cells in the living body possessed powers of "scavenging," passing here and there through the blood in the time of invasion by disease germs, overtaking the germs, absorbing them, and building them into their own protoplasm and thus absolutely destroying them. These scavenging cells (*phagocytes*) he found were derived from various cellular elements, normally present in the body. The body in which they were abundant was found to be insusceptible to certain diseases. The body in which they were few or inactive was susceptible. So it became evident that our protection from certain diseases depended on the capacity of our tissues to furnish many active phagocytes.

But brilliant as was this discovery of Metchnikoff, it was not the last word. For, in 1904, Sir Alfred Wright, of St. Mary's Hospital, made the further discovery that, even if these protective cells be removed from the blood, the blood itself still possesses protective properties. He found that the blood contains substances which combine with the micro-organisms in such a way as to prepare them for the phagocytes. Hence, he called these bodies in the blood serum *opsonins* (from a word meaning, "I prepare victuals for, I cater for"). No doubt there are many varieties of opsonins, but it is now fairly certain that healthy blood is protective against invading microbes not primarily because of the phagocytes but because of the opsonins. The difference between the activity of the blood serum of a patient and of a healthy person is known as the "opsonic index,"—for example, the normal unit is taken as one, and such and such a person's blood that gives opsonic index of 0.5 means that it is half as protective as

normal blood. Metchnikoff has suggested that, possibly, opsonins are a secretion of the phagocytes, which he still believes are the essential elements in immunity. However that may be we see from these facts that disease is arrested by various kinds of anti-bodies, which attack or combine with the microbes to prepare them for absorption by the phagocytes in the body itself.

In practice men have found that these principles really operate to the saving of life and the reduction of disease. The experience of generations of men have tested the truth that a person who has suffered from infective disease does not again, as a rule, immediately, and in some cases never again, suffer from the same disease. That has been known and acted upon for a long time, though it is only recently there has been forthcoming a reasonable explanation. For long centuries men aimed at protecting themselves from disease by avoiding contact with it. But in a complex civilisation this is well nigh impossible, and under such circumstances the more effectual means is immunity. We may here refer to two preventive inoculations by way of illustration and both of which are now used in the daily prevention of disease, namely *vaccination* for smallpox, and *antitoxin inoculation* for diphtheria.*

Vaccination.—In 1717, Lady Mary Wortley Montagu, the wife of the British Ambassador to Turkey, described the *inoculation of small pox* as she had seen it practised in Constantinople. This was an inoculation with mild small pox with the hope and object of getting this evil disease over

* There can be little doubt that as a result of the discovery of opsonins other new methods of treament by inoculation will arise.

as soon as possible rather than risking a severe attack of small pox, then very prevalent in England at a more inconvenient and fatal season. It was based on the principle that one attack protected, in some measure, from subsequent attack. The Montagu family were the first persons to be so inoculated in England, and for 120 years small pox inoculation (or *variolation* as it is more correctly termed) was practised in this country until by Act of Parliament in 1840 it was prohibited. There were different methods of performing variolation, but the most approved was a kind of arm to arm inoculation. As a rule only local results or a mild attack of small pox followed, which prevented another attack of the small pox. Nevertheless, it it was actually inoculating small pox, and it was a means of breeding small pox, for the inoculated cases were liable to create fresh centres of infection.

In 1796 Edward Jenner, a medical practitioner in Gloucestershire, observed that persons who were affected with *cowpox* contracted in the discharge of their duty as milkers, did not contract small pox, even when placed in direct infection. Hence, he inferred that inoculation with this mild and non-infectious disease was protection against small pox, and would at least be preferable to the process of variolation then so widely adopted in England. Jenner, therefore, suggested the substitution of cowpox lymph (*vaccine*) for the small pox lymph used in variolation. In due course, and after much opposition, the practice of vaccination took the place of small pox inoculation. We now know that the science at the back of it, so to speak, was that which we have been considering, namely, the introduction into the blood of toxins, which produced an anti-body resistant to small

pox. No doubt also vaccine contains anti-bodies itself.

Vaccination, though optional, was provided gratuitously by the Vaccination Act of 1840. It was made compulsory in 1854, enforced more or less between 1867-1872, and by means of paid vaccination officers after 1872. Under the Vaccination Acts of 1898 and 1907 more latitude and facility was allowed to the conscientious objector.

Now what have been the results ? Well, broadly it may be said that each extension of vaccination has been attended with a reduction in the small pox mortality, greatest at the ages of highest mortality (under ten years of age) and least in adults, and that, whereas a century ago, small pox was a pestilence in this country of the first magnitude, it is now a rare disease. That wonderful change cannot be due to improved sanitation only, for if it were so we should expect a proportional decline in all other infective disease, which has not happened. The general death rate in the last fifty years has decreased some ten per cent. But the small pox death rate has decreased more than seventy per cent. Nor is this all, for if the decline of small pox were due to sanitation we should find a proportional general reduction of the disease at all ages in relation to sanitation (for hygiene affects all ages), whereas what we do find is a change in *age incidence* of the disease, children and infants who have been vaccinated suffering *less* rather than more than adults, though their age is more susceptible to disease. Further, when we turn to the hard facts of small pox epidemics, the result is not less convincing.

The following are some of the official figures for the last London epidemic (1901-2) :—

AGES.	DEFINITELY VACCINATED.			DEFINITELY UNVACCINATED.		
Years.	Cases.	Deaths.	Mortality per cent.	Cases.	Deaths.	Mortality per cent.
Under 1	—	—	—	187	130	69.5
1-5	18	—	—	524	209	39.8
5-10	116	2	1.7	563	103	18.2
10-15	334	4	1.1	386	88	22.7
15-20	829	19	2.2	233	62	26.6
Total under 20	1,297	25	1.9	1,893	592	31.2
Total betw.20-80	5,648	680	12.0	384	160	41.6
Grand Total	6,945	705	10.1	2,277	752	33.0

It must be remembered that the vast majority of people in London are vaccinated, the unvaccinated are few. Small pox occurred in this epidemic all over London without any relation to sanitation, though, of course, it spread most in overcrowded areas and among the poorest classes. Yet, though children under five are the most susceptible of a community, only 18 vaccinated children at that age contracted the disease against 711 unvaccinated. The disease may almost be said to have passed over certain districts of London, *picking out the unvaccinated children*. The mortality among the well-vaccinated of all ages was only 10 per 100, among the unvaccinated it was 33 per 100. Evidence from Germany is even more overwhelmingly in favour of vaccination than is that obtainable in England.

Why, it may be asked, if vaccination protects, why did anyone who had been vaccinated get the disease? The answer to that question is twofold; first that primary vaccination only protects for nine or ten years; and secondly, that a vastly

greater number of vaccinated persons came within the pale of infection.

From these figures we may draw three conclusions: (1) That other things being equal persons who have been vaccinated within ten years or have been revaccinated *are less liable to attack* from small pox. (2) That when attacked, owing to their greater number and therefore greater probability of infection, vaccinated persons *do not die so readily from the disease* as those who have not been vaccinated. (3) That the protection afforded by vaccination is greatest during the years immediately succeeding the act of vaccination. One other point may be mentioned. If vaccination be indeed a protection, the degree of protection afforded will depend upon the thoroughness of the vaccination, whilst if vaccination had little or no effect in the reduction of the disease we should expect no difference between thorough and inefficient vaccination.

What are the facts? Let us take the same epidemic, and, measuring thoroughness of vaccination by the only available method, namely area of vaccination mark, note the result :—

Vaccinated Cases.	No. of Cases.	Deaths.	Mortality per cent.
Area of Vaccination marks:			
½ sq. in. and upwards	5,163	379	7·3
⅛ sq. in.	835	131	15.6
Less than ⅛ sq. in.	860	162	16.8
Not recorded	87	33	37·9
Total Vaccinated cases	6,945	705	10.1
Unvaccinated Cases	2,277	752	33.0

Here again, the answer is not doubtful.

Finally the question arises: Does vaccination do any harm? The answer is that if properly performed, and the inoculation is made with pure calf lymph, there is little or no risk or harm. People sometimes say that syphilis may thus be conveyed, forgetting that syphilis is not a disease of the calf, and that though vaccination is enormously increasing, syphilis is steadily declining as a cause of death. No doubt many cases of vaccination have fared badly, but the protection which it has afforded, when properly and effectually performed, has been very remarkable.

Antitoxin Inoculation for Diphtheria.

The other illustration of preventive inoculation to which reference may be made is the use of antitoxin for diphtheria. This is an inoculation not of a disease, nor yet of a weakened virus, but it is an injection of *anti-bodies* from the blood of an animal which has suffered from the disease. In such blood, as a result of the action of the toxins on the body cells, there is produced the counteracting bodies to the toxins, namely, the antitoxins. To be of value antitoxins must be used early before tissue change, and before the toxins have, so to speak, got the upper hand. When the toxins are in the ascendancy the patient suffers more and more acutely, and may succumb before there has been time for the formation in his own body of the antitoxins. If he can be tided over the crisis all will be well, for then his own antitoxins will be available. In the meantime the only way is to inject antitoxins prepared in some other animal's body whose disease began at an earlier date.

Such an animal must be one that can stand an attack of diphtheria and from whose body a considerable amount of blood can be drawn without ill effect. The horse meets these requirements, and it is in its body that diphtheria antitoxin for human use is now produced. The result of inoculating persons suffering from diphtheria with such antitoxin may be seen in the following return of all forms of diphtheria treated in the hospitals of the Metropolitan Asylums Board, which receive the cases of this disease in London :—

	Cases.	Deaths.	Mortality per cent.
1890-1893 (before antitoxin) ..	7,111	2,161	30.3
1894 (antitox. occasionally used)	3,042	902	29.6
1895-1899 (antitox. used) ..	21,551	4,216	19.5
1900-1904	29,263	3,424	11.6
1905	3,734	335	9.0
1906	4,149	432	10.4

A similar decline has taken place in New York, Berlin, Paris, and Vienna. Antitoxin is, of course, most effectual when injected in the first day of the disease. When this is done the mortality almost vanishes. It should not, however, be forgotten that earlier notification owing to bacteriological diagnosis explains some part of the reduction apparently due to antitoxin.

CHAPTER VII.

THE WHITE MAN'S PLAGUE.

"No war which has ever been waged by the human race has brought with it anything like the burden of misfortune which tuberculosis has from time immemorial carried with it to the people of the world."—LORD LANSDOWNE at St. James' Hall, London, July 22nd, 1901.

"If the prevention of tuberculosis is to be effectively carried out, *the general public must aid* the physician and the surgeon in the endeavour."

—LORD LISTER on the same occasion.

TUBERCULOSIS is the white man's plague. In England and Wales it slays every year more than 50,000 people. (In 1905, 55,759). In London alone it kills 9,000 a year, and the vast majority of its victims are young men and women at about the prime of their age. Little wonder that John Bunyan spoke of it as "the captain of the men of death." It is, however, not only a cause of suffering and of death of the first magnitude, but because of its economic results it is also a great social evil. Yet it is one of the most preventable of diseases.

In 1882, Koch showed that tuberculosis was a germ disease and was due to the tubercle-bacillus. Ten thousand tubercle bacilli placed end to end would stretch the length of an inch. The bacillus takes the form of a slender, slightly bent rod, but sometimes it grows in chains and even branches. It can live in nature apart from the human body, and grows slowly under favourable conditions. It can exist for long periods under unfavourable conditions. It probably produces seeds or spores smaller even than itself which are more resistant and hardy than itself. It is also a parasite and lives and multiplies in man and other animals. It is quite possible there is a family of them, each one differing in some respects from its relative according to the animal in which it lives, and so we speak of the human tubercle bacillus, the bovine, the avian, etc. It can also live in cold-blooded animals. It is the agent and primary cause and origin of tuberculosis. As we have already seen disease depends upon soil as well as seed, and in tuberculosis this is particularly true. If the soil, that is the human body attacked, be favourable, the bacillus will produce the disease of tuberculosis, if unfavourable the disease will not occur or at all events will not appear. Tuberculosis takes different forms according as different parts of the body are attacked. Tubercle of the lungs we call consumption or *phthisis*; tubercle of the skin of the face is called *lupus*; in the mesenteric glands of the body, *tabes mesenterica*; in the brain *hydrocephalus* or *tubercular meningitis*; or in the lymphatic glands, *scrofula*. These are all forms, generally speaking, of one and the same disease, though commonly when we think of tuberculosis we mean consumption or tuberculosis of the lungs.

How Tuberculosis is produced and spread.

These various forms indicate to us the sort of ways, or channels, of infection, which are mainly three. First, the bacillus may gain access through the skin by inoculation, setting up a local or a more general disease. The exact means and occasion of such entry are innumerable, wounds playing a considerable part. Then, secondly, infection may take place by way of the alimentary canal, by children sucking dirty and infected objects, by kissing tuberculous people or by taking infected food, such as tuberculous milk or meat, and in this way the disease may start in some part of the digestive system. The chief channel of infection by the tubercle bacillus is, however, the respiratory tract, affecting the lungs. Consumption is a disease, in the main, which is breathed in, and it is this which makes people speak of it as an infectious disease. But in truth, it is not very infectious, like measles for example, and is more correctly thought of as sub-infectious. It is very rarely indeed transmitted directly by heredity. However the germ gains access, it behaves in much the same way, and to follow its action we may suitably consider what takes place in the lung attacked by this microbe.

In arriving at an understanding of this matter, we do well to remember that a microbe has a double effect. First, by its presence, it sets up an inflammatory irritation (as does a particle of dust in the eye), and secondly, it exerts a specific effect by its products or toxins. Now what happens in tuberculosis of the lung is this: as soon as the tubercle bacillus finds itself lodged in a favourable

nidus, say in the apex of a weak or inexpansive lung, it begins multiplication within the cells of the lung. This increase in number acts as an irritant on the surrounding tissues. There is congestion and rapid cell growth with the result that "inflammation" occurs. In this way nature attempts to surround the invader with a wall of protective tissue. The organism is, so to speak, hedged round with the products of inflammatory action (with what are termed exudation cells, epithelioid cells, lymphoid cells, giant cells, and so forth), and becomes a nodule closely shut in from the air passages of the lung, and from the small blood vessels which become annihilated. Possibly the infection may spread by the smaller lymphatics, possibly in some way from cell to cell, but if the infection gains ground it is evident that we shall have a number of such tuberculous nodules or tubercles. Indeed, parts of the lung may become solid with such nodules. But it does not very long remain so. Partly owing to the production of toxins by the bacilli, partly owing to the cells in the middle of the nodule dying for want of blood, the nodule breaks down in the centre. If the nodule be in a gland in the neck we get it "pointing" and eventually discharging; if the nodule be in the lung we get the same, but the discharge is coughed up and becomes "expectoration." Both discharge and expectoration originate from the breaking down of the new celled formation, and when quite fresh, contain countless myriads of tubercle bacilli, which may thus be disseminated. And it will be evident that if the centre of the nodule degenerates and comes away like this, a cavity will be left behind, and thus parts of the lung are destroyed.

Now, with these facts in mind, it is not difficult to see the two ways of transmission of this disease, namely, by sputum and by cough-spray. A person with consumption is winning or losing. If he be winning it means that his body is too resistant for the bacillus to gain an effectual lodgment, if he be losing ground it means he is slowly losing his lungs. Much can be done to prevent this as we shall see. But for the moment let us suppose that nodules are produced which eventually discharge in the form of sputum. The sputum is coughed up, falls on the ground, soon dries, and its dust, which contains millions of bacilli, mixes with the dust of the street or room. This dry dust is readily blown about and inhaled and so the disease may be spread to healthy persons. It has been estimated that there are upwards of 30,000 fresh cases of consumption in London alone every year. It cannot be doubted that many of these are produced in just this way ; namely, by inhalation of infective dust. " The main source of the infection of tuberculosis," said Koch, " is the sputum of consumptive patients." Recently it has been shown that in shouting, sneezing, coughing and the like, a mucous spray of moist particles passes from the mouth into the surrounding atmosphere capable of carrying germs, and that in consumption such a " cough spray " may convey the tubercle bacillus. Heymann has shown that some of these particles may remain suspended in the atmosphere for more than an hour, retaining, of course, their infective properties. He has also found that the duration of life of tubercle bacilli in these tiny droplets was about three days in the light and some eighteen days in the dark. Though it is impossible exactly to allocate the degree of infection to be derived from dried sputum

or from cough spray it is evident that both may be dangerous.

Tuberculous Milk. The same sort of interpretation applies to tuberculous milk. The udder of the cow is invaded by tubercle bacilli ; tuberculous nodules are formed in its tissues ; they discharge and contaminate the milk, which becomes therefore highly virulent ; and as the disease is slow, the udder may be producing infective milk for many months. Sir John McFadyean has estimated that about two per cent. of the cows in the milking herds in this country have tuberculous udders.* This means there must be many thousands, for there are upwards of four million cows in the United Kingdom ; and if each tuberculous udder produces in a year 500 gallons of milk, as an average, it becomes clear that a large quantity of milk is produced, amounting to many millions of gallons, which is at least open to suspicion, if not absolutely poisonous. It is not contended that milk spreads tuberculosis at all in the same degree as sputum. But there is now indisputable evidence that it does spread this disease. Market milk is not examined by Sanitary Authorities as a rule for tubercle, but where that has been done it has not infrequently been found to contain the germ in a considerable percentage of cases, varying from one to twenty-two per cent in English towns.†

Some doubt was cast on this channel of infection by Dr. Koch at the London Congress on Tuberculosis in 1901, and so important was it to have the matter cleared up that a Royal Commission was appointed to go into the whole question.

* *Trans. Brit. Cong. on Tuberculosis.* 1902. Vol. 1. p. 84.

† *Bacteriology of Milk*, pp. 218-220.

The Commission was instructed to inquire into and report as to whether the disease of tuberculosis in animals and man is one and the same ; whether animals and man can be reciprocally infected with it ; and under what conditions, if at all, the transmission of the disease from animals to man takes place, and what are the circumstances, favourable or unfavourable, to such transmission.

The important results so far attained by the Commission (1907) may be summed up in the following conclusions :—

1. That the effects of the bacillus of bovine and the bacillus of human tuberculosis are one and the same, though wide variation in degree of virulence may occur.
2. That the human body can be infected by bovine tuberculosis ; and the bovine body can be infected by tuberculosis of a human source.
3. That there can be no doubt but that in a certain number of cases the tuberculosis occurring in the human subject, especially in children, is the direct result of the introduction into the human body of the bacillus of bovine tuberculosis ; and there can also be no doubt that in the majority at least of these cases the bacillus is introduced through cows' milk. *Cows' milk containing bovine tubercle bacilli is clearly a cause of tuberculosis and of fatal tuberculosis in man.*
4. That a very large proportion of tuberculosis contracted by ingestion is due to tubercle bacilli of bovine source.
5. *That a very considerable amount of disease and loss of life, especially among the young, must be attributed to the consumption of cows' milk*

containing tubercle bacilli. The presence of tubercle bacilli in cows' milk can be detected, though with some difficulty, if the proper means be adopted, and such milk ought never to be used as food. There is far less difficulty in recognising clinically that a cow is distinctly suffering from tuberculosis, in which case she may be yielding tuberculous milk. The milk coming from such a cow ought not to form part of human food, and indeed ought not to be used as food at all.

6. That our results point clearly to the necessity of measures, more stringent than those at present enforced, being taken to prevent the sale or the consumption of such milk.*

What are the Predisposing Conditions which favour Tuberculosis?

We have seen that this disease is an excellent example of illness due to seed and soil, that the latter is as important as the former. We now know that consumption is an *acquired* disease, and is not spread much, if at all, by heredity. What counts is not heredity but predisposition, that is influences, circumstances and conditions which weaken the body and prepare it for the attack of the tubercle bacillus which is widely distributed. Now what are these predisposing conditions?

1. First, there are *certain bodily conditions.* There may even be an inherited disposition to tuberculosis. Whether that be so or not it is known beyond doubt that some diseases predispose the body to tubercle. To understand this we must remember that before the invading hosts of bacilli can gain foothold they have to run the gauntlet of

* 2nd Report of Roy. Com. on Tuberculosis, 1907, pp. 20-37.

many opposing forces. There are the "phagocytes" and the "opsonins" in the blood, but before they get to the blood there is the first line of defences of the body to overcome. Two of these defences may be named, first, correct breathing, and secondly, lymphoid tissue at the entrance to the gullet and the windpipe. Correct breathing means breathing through the nose and not through the mouth, and the internal anatomy of the nose is so constructed as to waylay incoming bacteria. Then, surrounding the top of the gullet and windpipe are two rings of lymphoid tissue adjoining the tonsils and together with the tonsils they are capable of resisting attack and of dealing with micro-organisms even of a virulent type (Sims Woodhead). Now, any disease, however trifling, which causes mouth-breathing, or which removes the beneficial effect of the lymphoid tissue is a disease which predisposes to tuberculosis. Measles, bronchitis, catarrh, and what are called "adenoids," at the back of the mouth, all contribute in this way to predispose to consumption. To these must be added all and any sicknesses which weaken the body or lower its resistance. In this way it will be seen that tuberculosis has "an ancestry of causes" rather than one. Nor must it be forgotten that contracted and ill-formed chests predispose to the disease.

2. Secondly, there is *the effect of housing*. Living in dark, damp, dirty, and overcrowded dwellings predisposes to the disease. Light is one of its greatest enemies. Sunlight kills the bacillus and increases the resisting power of the body; and thus the reverse of sunlight, namely darkness, acts in an opposite way. Dampness of houses and of soil has also been shown to act as a favouring

agent to tubercle, most probably by lowering the resistance of the body. The dirty house in which a consumptive has lived may retain infection for long periods, and so we get "tubercle infected houses." It has been shown in Manchester that in sixty-six per cent. of such houses virulent bacilli are present in the dust, and even in fifty per cent. of clean houses where a careless patient has lived the bacilli have been found in the dust, whereas even in very dirty houses, where there has been no consumptive, no tubercle bacilli have been found (Coates). So that we may say that about sixty per cent. of houses where consumptives have lived *remain infective* for a shorter or longer time. In Berlin it was found that the percentage was seventy-one (Cornet). In Finsbury we have found that thirty per cent. of the cases of consumption arise in houses where there has been a previous case within ten years. It was such facts as these which led Koch to say that "it is the overcrowded dwellings of the poor that we have to regard as the real breeding places of tuberculosis; it is out of them the disease always crops up anew, and it is to the abolition of these conditions that we must first and foremost direct our attention if we wish to attack the evil at its root."*

3. The effects of *overcrowding* are discussed elsewhere and we need not, therefore, go into the subject very fully here. Overcrowding, however has a definite influence in propagating tuberculous disease. There are Sir Shirley Murphy's figures (see chap. xii.), which are convincing enough. But to that we may add the fact that phthisis varies in proportion to density of population. The

* *Trans. Brit. Cong. on Tuberculosis*, 1902, Vol. I., p. 31.

agricultural counties without large towns, like Worcestershire, Herefordshire, Buckinghamshire and Rutland are the counties having the lowest mortality from phthisis, whilst the crowded populations in Northumberland, South Wales, Lancashire, London and the West Riding suffer most. In 1905 phthisis was higher in the urban counties of England and Wales than in the rural by 19.3 per cent. Even in the large towns phthisis follows density to the acre. In the centre of London, or Manchester, or Birmingham, phthisis mortality is higher than on the circumference of these towns. There are of course many causes for this, but, undoubtedly, one is density of population, that is overcrowding. Dr. Robertson, the medical officer for Birmingham, has shown that in the overcrowded Floodgate area in the centre of the city during the five years 1899-1903 the phthisis death rate was 3.7 per 1,000 of the population, whereas in Edgbaston it was only 0.93, that is to say, four times less.

4. *Occupation* too often acts as a predisposing circumstance, particularly those occupations which interfere in one way or another with the full play of the lungs. Cramped and constrained position of the body when at work, as in miners, cobblers, lace-makers, strawplait makers, bookbinders; night work, hot workrooms, and ill ventilation as in printers; and all trade processes in which the air is charged with organic or mineral dust of an irritating kind. Any occupation which either contaminates the lung or limits the natural expansion of the chest operates in the same way. Impurity of the atmosphere whether from respiration or dust has much to do with this.

5. Among other predisposing conditions, *alcoholism* is important. Professor Brouardel, of

Paris, speaking in London in 1901 said that "alcoholism is the most potent factor in propagating tuberculosis," and he quoted Baudran as showing that the deaths from tubercle per 10,000 rise in proportion to the annual consumption of alcohol per head. In this country the Registrar General has shown that more than one quarter of the deaths of innkeepers and their servants in London result from phthisis; more than one third of the deaths of public-house servants, barmen and potmen in London are due to phthisis; and the mortality from this disease among London innkeepers and their servants is more than twice as great as amongst all occupied males, and the mortality amongst the servants alone is more than three times as great. These are very striking figures. No doubt some of this mortality is due to inhalation of tuberculous dust from dried sputum on the floor of the public-house.

Means of Prevention.

Before we consider briefly what are the available methods of prevention of tuberculosis there are two preliminary questions to ask. Is consumption curable? and is it declining, and if so why? The answer to the first question is Yes, consumption, if taken in its earliest stages, is eminently a curable disease, and even later on it may be in some degree arrested. Medical knowledge shows that a large part of the population are attacked in some degree by the tubercle bacillus and yet survive, and examinations of the human body after death from some other cause reveal the repaired wounds of tubercle. From the experience of these two facts it is proved that the disease may be arrested and even cured. Life in the fresh air; abundance

of good, nourishing food, containing plenty of fat, in small frequent meals; plenty of sunlight; suitable woollen clothing; cold water baths; and mild, regular exercise, are five of the means by which nature heals tuberculosis.*

And to the second question also the answer is, Yes, tuberculosis is steadily declining. In 1861-1865 the death rate from phthisis in England and Wales was 256 per 100,000 persons; in 1901-1903 it was 123, and that marked decline has taken place steadily through the whole period. Nor is England alone. In Massachusetts in America, the disease has declined within the same period from 365 to 167 per 100,000 people. If we can find out to what this decline is due it will indicate to us the broad lines of future progress, for we must work towards the day when tuberculosis will be as extinct in England as leprosy. **The causes of this decline** are now generally believed to have been the following :—

a. Improved sanitation of dwelling and work places.
b. Improved nutrition and social life of the people.
c. Education as to the infectiousness of consumption and consequent action.
d. Improvement in the milk supply.
e. The separation of consumptives, especially in an advanced stage of the disease, in general hospitals, infirmaries and asylums.

Dr. Newsholme, of Brighton, holds that the last-named has exercised the predominant influence in bringing about the reduction. Whether that is so or not, it is quite certain that it is a most important agency in reduction. In Finsbury sixty

* *Treatment of Phthisis.* By Arthur Ransome, M.D.

per cent. of the phthisis deaths occur in institutions, that is to say away from the home of the person dying, which means that an enormous mass of infection is removed from the community. But without attempting to apportion the part played by each agency there can be little doubt that the decline which has occurred is due to these five causes rather than to any special measures of prevention applied directly to the disease, for it is only in recent years that such measures have come into vogue. In the future we cannot do better than learn the lessons of the past, and make more operative, if possible, the forces which have brought about the substantial decline which has taken place.*

New occasions, however, teach new duties. There are means of prevention now available which have not been to hand hitherto, and these may well be added to the five methods already named. First, there is *notification.* In New York, in Sheffield, and in Edinburgh, there is in vogue compulsory notification of consumption similar to the ordinary notification of certain infectious diseases as required by law. In Brighton, Manchester and a majority of the London Boroughs a system of voluntary notification has been adopted, by which medical practitioners are encouraged to notify to the sanitary authority the cases of the disease with which they meet and for which ordinary notification fees are paid. The object of such notification is, of course, to obtain information as to the prevalence of the disease in order to apply preventive measures. There are,

* For the most valuable contribution to the whole of this question see Dr. Newsholme's paper in the *Journal of Hygiene*, 1906 (Vol. vi.), pp. 304-384.

no doubt, some difficulties in the notification of such a disease as phthisis, but the advantages are substantial, both in the way of obtaining facts as to the incidence of the disease and in the giving of advice as to precautions to prevent its dissemination, and suitable counsel for the benefit of the patient. Then secondly, there is *disinfection*. Periodically and always after death from consumption, very thorough disinfection should take place. Spittoons, containing liquid disinfectant should be used for expectoration; handkerchiefs should be disinfected; and from time to time the room and belongings of the patient, for as we have seen the disease is spread by the dissemination of living tubercle bacilli. It is important, therefore, to do all we can towards annihilation of these foes. Most important of all is it to stop the filthy habit of promiscuous spitting in public places. Thirdly, there is the question of *isolation* of diseased persons, partly for their own benefit, partly to remove centres of infection from a community. Reference has already been made to the influence of isolation in institutions in diminishing the disease. Suitable and fairly cheap sanatorium accommodation is badly needed almost everywhere. There are, at this moment, thousands of consumptives in our large cities steadily getting worse, and without hope of improvement because there is no appropriate and available sanatorium accommodation for them.* The provision of such places is not only likely to be the means of repair of young men and women consumptives in the early stages of the disease, and thus be of great social value, but it is also a direct means of stopping the spread of

* For "Hints for the Consumptive at Home" see *Tuberculosis*, November, 1906, p. 141.

the disease in the overcrowded homes of hard working people. Indeed, there are few needs so pressing at the present time, in respect to public health, as this requirement. Existing sanatoria are, as a rule, so expensive that they are only of use to wealthy persons. Some attempt has been made by the Friendly Societies to meet this need, and several sanatoria for working men are being established. But scores of them are urgently needed.

The Great Lines of Reform.

Finally, in seeking to improve our existing sanitary machinery of prevention we must always keep steadily in view what we have seen to be the great lines of reform. Phthisis will decline in response to these broad measures rather than to any narrow means of grappling with it at the eleventh hour. What heals the individual consumptive in the early stage of the disease will heal the community if rightly applied. Sunlight, fresh air, nourishing food, healthy houses—these are, so to speak, our sheet anchor. Clean, pure milk from tubercle-free herds, a well-drained soil for house foundations, an atmosphere free from smoke and the waste products of respiration, efficient ventilation of houses (and particularly of bedrooms where people spend one third of all the years of their lives), open spaces in and around our crowded cities—this is the great line of defence, as it is a line of true social reform, against the white man's plague.

CHAPTER VIII.

INFANT MORTALITY.

"A revolution in the economic incidence of the burden of child-bearing would leave the way open to the play of the best instincts of mankind. To the vast majority of women and especially to those of fine type, the rearing of children would be the most attractive occupation, if it offered economic advantages equal to those, say, of school teaching or service in the Post Office. At present it is ignored as an occupation, unremunerated, and in no way honoured by the State. Once the production of healthy, moral, and intelligent citizens is revered as a social service and made the subject of deliberate praise and encouragement on the part of the Government, it will, we may be sure, attract the best and most patriotic of the citizens."—SIDNEY WEBB in the *Times*, October 16th, 1906.

INFANTS are children under twelve months of age, and the infant mortality rate is the proportion which the deaths of such infants bears to every thousand births. An ordinary death rate is the proportion which the total deaths of a community bears to a 1,000 of the population. We say, for instance, that the death rate of London in 1906 was 15 per 1,000, by which we mean that in every 1,000 people living in London 15 died during

1906. In some towns this figure rises to about 25, in others and in rural districts it may fall to 10 per 1,000 people living in the district. But it is clear that a more accurate way of recording the death rate of *infants* is not per 1,000 persons living but per 1,000 born in the same year. In some places this figure is as low as 80 per 1,000 births, which means, of course, that for every 1,000 children born in the year 80 die before they are twelve months old. In other places it is found that this infant mortality rate is high, say 160, or even 200 or 250 per 1,000. A low rate, other things being equal, indicates a healthy community, a high rate the reverse.

There are three chief reasons why a high infant mortality rate is a matter of grave importance. First, a high mortality rate indicates a heavy loss of young lives by death. In 1905 there was, for instance, a loss to the nation of 120,000 infants dying under one year of age in England and Wales alone. This loss is being repeated year after year and is not growing less. So that in view of the marked decline in the birth rate which is taking place the loss becomes very grave. We are burning the candle at both ends. Fewer children are born and yet there is the sacrifice continually going on. Secondly, the circumstances and diseases which kill 120,000 infants every year, maim and injure the children who survive. Some only survive a few months, but others linger on and even grow up to adult age. Nevertheless, it cannot be doubted that many of them are as brands plucked from the burning, and bear the mark of death upon them. It is idle to wonder at physical degeneration if the majority of the nation's infants have before they grow up to pass under such unfavourable

influences as are able to kill 150 in every 1,000. A high infant mortality must therefore be taken, as Sir John Simon said, to denote a prevalence of those causes and conditions which, in the long run, bring about a degeneration of race.* Thirdly, a high infant mortality indicates the existence of evil conditions in the mothers and in the home-life of the people. It is an index of *social* evil. Poverty is not alone responsible, for in many poor communities the infant mortality is low. Housing conditions and external surroundings generally do not alone cause it, for under some of the worst external conditions in the world the evil is absent. There must be something else more intimately connected with social life, and more personal, than these things, which we must now consider. And to discover the true cause we must first learn the true state of the problem.

Characteristics of Infant Mortality.

When we come to look more carefully into the death of infants we shall find some interesting facts. The general death-rate and the special death rates for most diseases are year by year declining, while the infant mortality is stationary, in some places slightly falling, in others rising. This is shown in the table on the following page.

The first fact to get hold of, then, is that infants are not sharing in the general improvement and decline in sickness and death rates which has occurred at other ages. Nor is this only the case in England.

* Dr. Kerr has shown that school children who were born in years of high infant mortality have a poor physique. (Report of medical officer of L.C.C. Education Committee, 1905, pp. 8-11).

	ENGLAND AND WALES.			LONDON.		
	Birth Rate per 1,000 of Population.	Death Rate per 1,000 of Population.	Infant Mortality Rate per 1,000 Births.	Birth Rate per 1,000 of Population.	Death Rate per 1,000 of Population.	Infant Mortality Rate per 1,000 Births.
1851–60	34.1	22.2	154	33.6	23.7	155
1861–70	35.2	22.5	154	35.4	24.4	162
1871–80	35.4	21.4	149	35.4	22.5	158
1881–90	32.5	19.1	142	33.2	20.5	152
1891–1900	29.9	18.2	154	30.2	19.6	160
1901–05*	28.4	16.0	138	28.4	16.5	141

It is even worse in Germany, Austria, Spain and Russia, where the infant mortality is higher than in this country. Whereas in Scotland and Ireland, in Australia and New Zealand, and in Norway and Sweden, the case is very different. There the mortality among infants is low and is declining along with the other death rates.

Another fact which soon emerges in response to a little study of the matter is this, namely, that infant mortality is greatest *in the first few weeks* of the first year. When we think of 150 infants out of every 1,000 born dying before they are twelve months old, we must not think that the deaths fall more or less equally and uniformly throughout the first twelve months. As a matter of fact one fifth of the total loss of life in infancy occurs in the first week of life, one third of the deaths occur in the first month, and about half in the first three months.† Farr expressed this by saying that the

* For a five year period only, as compared with the ten year periods.

† *Sixty-Eighth Annual Report of Reg. General*, 1905, p. cxviii.

infant mortality in England was 570 per 1,000 births under one month, and 91 under eleven months, whereas in a town, such as Liverpool, it was 672 for infants under one month and 280 for infants under eleven months. The point of importance is that the burden of mortality falls most heavily upon the first weeks of life. Further, as I have elsewhere shown, this is increasingly so* ; for while the death rate of infants aged three to twelve months is decreasing, the death rate among infants *under three months of age* is increasing. It should also be remembered that the death rate of *illegitimate* infants is nearly twice as high as that of legitimate infants.

Again, another fact to consider is that infant mortality is higher in towns than in rural districts, and higher in manufacturing than in agricultural districts. For instance, the West Riding, Lancashire and Staffordshire are high mortality districts, whereas Wiltshire, Dorset and Westmoreland are low mortality districts. Infant mortality in fact is largely a curse of the towns, and occurs in them in excess of the rural districts mostly in the late months of the first year of life. It also occurs more in the central, poor, and densely crowded areas of towns than in the better districts. The high infant mortality rates in London are in Shoreditch, Southwark, Bermondsey, Bethnal Green, Poplar, and Finsbury ; the low ones are in the comfortable and airy districts of Hampstead, Marylebone, Lewisham, and Stoke Newington. In 1905 urban infant mortality was thirty per cent. in excess of rural ; they are almost the same in the first week of life, but in the later months of the year the urban is fifty per cent. in excess of the

* *Infant Mortality* (Methuen), pp. 12-14.

Size of Tenement.	Census Population, 1901.	INFANT MORTALITY PER 1,000 BIRTHS.					
		All causes.		Diarrhœa, and other Zymotic Diseases.		Prematurity. Immaturity	
		1905	1906	1905	1906	1905	1906
One-room tenement	14,516	219	211	53	67	30	69
Two-room tenement	31,482	157	178	42	56	26	48
Three-room tenement	21,280	141	188	34	43	44	55
Four-room tenement and upwards of four rooms	33,185	99	121	19	26	19	52
Borough of Finsbury	101,463	148	157	37	45	27	48

rural. Half of this excess is due to epidemic diarrhœa.* In Finsbury we have followed the matter up and find the highest infant mortality rates occur in the one-roomed homes and the lowest in the four roomed homes, as the preceding table for 1905 and 1906 shows.

It is noticeable that immaturity occurs less, in proportion, among the very poorest people.

Ante-natal Influences. Lastly, when we examine this town incidence more carefully, we find that it is a *mother-incidence*, and that infant mortality bears relation to two circumstances affecting the lives of mothers, first, the ante-natal influences, and secondly, the occupation of the mother away from home. As to the ante-natal influences a word of explanation is necessary. There are three main physical influences affecting the unborn child. First,

* *Sixty-Eighth Annual Report of Reg. General*, 1905. p. cxxxii.

there is what has been called the *germinal*, or hereditary influence, that complex series of conditions which give the character and physique to the parents, which is transmitted to their children, an influence which depends upon generations of ancestry, upon nourishment, and upon physical equipment generally. This influence depends of course upon good life and good blood and reveals the immense importance of marriage between healthy people. Secondly, there is the *embryonic* period which follows immediately upon conception, and which has to do with the health of the germinal cells in the parents. Thirdly, there is the *fœtal* period, which fills by far the larger part of the nine months before the child is fully formed and ready for birth. This is almost wholly of course a maternal influence.

The accompanying chart will make these ante-natal influences clear to the mind of the reader.

It is impossible to say which period of the three most impresses the physique of the infant before birth, but it is certain that all of them taken together—that is, the ante-natal influences—exert an enormous effect upon the child, and which has, of course, much to do with its survival or death. More important even, as a maternal influence, is the nine months before birth than the first nine months after birth, though this latter period must in no sense be neglected. The neo-natal period, that is the first month after birth, is occupied in the attempt of the infant to adapt itself to its new surroundings. The beginning of the exercise of vital functions must of necessity be a severe testing time as to physical fitness, or otherwise, for survival. As we have seen, thousands of new-born infants every year fail to survive. For the

Months.		
0	Germinal Period before Conception. Male. | Female.	CONCEPTION. *Organogenesis.*
	Embryonic Period.	
2		
4	Fœtal Period.	*Growth of Fœtus.*
6		
8		BIRTH.
	Neo-natal Period.	*Adaptation and Adjustment to new Environment.*
10		
12		
14	Post-natal Period.	*Growth of Infant.*
16		
18		
20		INFANCY ENDS.
22		*Growth of Child.*

infant may be born already diseased or ill-formed ; or it may be born predisposed to disease ; or it may be so frail as to find itself unable to cope with its new surroundings of diet, temperature, and means of respiration ; or it may be born dead (still-birth). These states vary according to the ante-natal conditions, and of those which most directly concern infant mortality there are four, namely, *infections*, *toxæmias*, *prematurity* and *immaturity*. Among the infections are Small-pox, Syphilis, and various diseases which act injuriously on the unborn child through its mother, and indeed often prove fatal. The chief Toxœmias (or blood-poisonings), are Lead-poisoning* and Alcoholism† in the mother which so frequently bring about still-birth, or disease in the infant. Prematurity implies of course a too early arrival, and immaturity includes conditions of disability with which infants are sometimes born.

The occupation of the mother away from home has long been recognised as an important factor in the causation of infant mortality. Sir John Simon showed by his inquiries into the sanitary condition of England between 1859 and 1865 that in proportion as adult women were taking part in

* In 1860 C. Paul recorded 112 pregnancies in women suffering from lead poisining, which resulted in only thirteen living children after four years. The Factory Report for 1897 gives a return concerning seventy-seven married women who suffered from lead poisoning and of whom fifteen were childless, eight had twenty-one still-born children, and thirty-five had ninety miscarriages ; out of 101 living children born to these seventy-seven women, forty died in infancy.

† Dr. W. C. Sullivan has shown that 55 per cent. of the children of drunken mothers died under two years of age, as compared with 23 per cent. of the children of sober mothers.

factory labour or in agriculture the mortality of their infants rapidly increased, and that in various districts which had such employment the death rate of infants had been from two and a quarter to three times as high as in standard districts, and that in some districts more than a few infants were dying from ill-treatment which was almost murderous.* Fifty years have but added further evidence of this relation, and if a careful study of the question be made it will be found, other things being equal, that in places where married women at child-bearing ages are mostly occupied away from home the infant mortality is above the average.†

The following table gives three illustrations of how this influence of occupation away from home operates :—

Infant Mortality, 1896-1907.			Percentage of Married Women between ages 15 35, engaged in occupations away from home.
Burnley	..	208	59.7
Bury	..	164	44.8
Burton	..	119	2.0

It should be remembered that other conditions besides mere employment of women exert an effect. The effect of occupation depends (1) upon the conditions and character of the work ; (2) upon the length of hours of work ; (3) upon employment immediately before and after child birth ; (4) upon the sanitation of the workshops ; but,

* *English Sanitary Institutions* (1890), p. 298.

† *Infant Mortality*, pp. 90-138.

most of all, (5) upon the absence of the mother from the home.

Notwithstanding all these risks it must not be forgotten that approximately 80 per cent. of all infants are healthy when born. There would appear to be a "mean physical standard" which is the inheritance of the people as a whole, and that no matter how far certain sections of the people deviate from this standard by physical degeneration due to evil habits, poverty, or insanitary environment, the tendency of the race as a whole is to maintain the inherited average standard of healthinesss at the time of birth. In an investigation recently made in Finsbury we found that of every 100 children born seventy-three were healthy at birth.

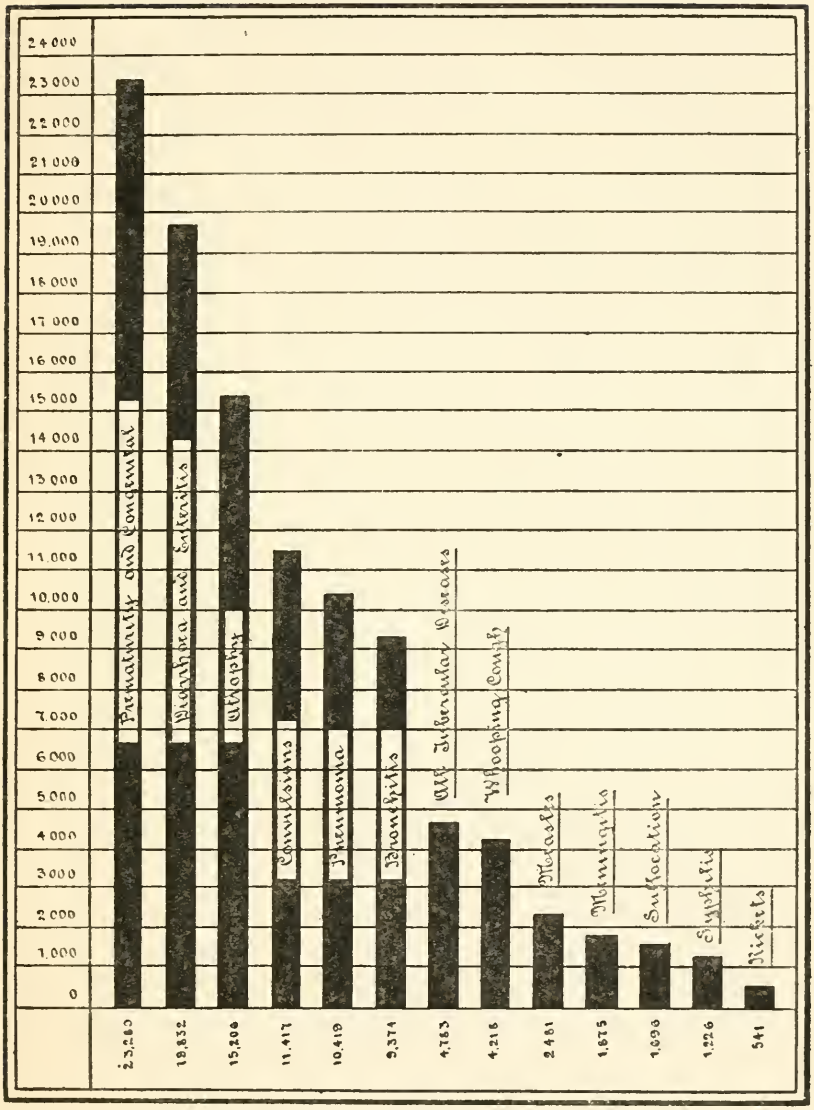
The Fatal Diseases of Infancy.

We must now briefly consider the diseases from which infants die. Broadly speaking, there are three main conditions which are the cause of seventy per cent. of all infant deaths :—

1. Immaturity, prematurity, debility, wasting, atrophy (40,000).
2. Diarrhœa and convulsions (30,000).
3. Pneumonia and bronchitis (20,000).*

Immaturity and general weakness bring about death in the first few days or weeks of life ; diarrhœa causes death generally from about the fourth to the ninth month (*i.e.*, particularly at the time of weaning) ; and lung disease affects the child

* The numbers are the approximate deaths of infants from these diseases in England and Wales in 1905. The Sixty-Eighth Report of the Registrar General for 1905 contains a large amount of new matter respecting infant mortality in England well worthy of careful study. (Wyman and Sons. 2s. 6d.).



THIS CHART ILLUSTRATES THE THIRTEEN PRINCIPAL CAUSES OF DEATH IN INFANCY IN ENGLAND AND WALES IN 1905.

throughout the whole twelve months of the first year.

Some thirty per cent. of the total deaths are due to immaturity. Under this term is included prematurity (children born before their time), developmental or congenital diseases, atrophy, marasmus and wasting—all that group of conditions which means that the child has been born prematurely, or so weakly as to be unfit to survive a separate existence from its mother. It is indeed less a question of actual disease than of mere unfitness to live. Eighty-five per cent. of these deaths occur within the first three months. I have elsewhere shown* that in England and Wales since 1866 and in London since 1845 there has been a marked increase, in London amounting to seventy-one per cent., in the number of deaths attributed to immaturity. Allowing for discrepancies due to medical certification, it cannot be doubted that there has been, during the last half-century, a steady increase in the number of children born unfit to maintain mere physical existence.

It is obvious that this condition of things must be due, in large measure, to the physical condition of the mother, rather than to food or external conditions. The child dies because it is not born strong enough to live. In Finsbury we have found that more than half the mothers of infants dead of immaturity suffered from marked ill health and poor physique; that 76 per cent. of them had previously had miscarriage; that 10 per cent. of them were under-fed; and that 22 per cent. of them did hard work during pregnancy.†

* *Infant Mortality*, pp. 54-60.

† *Report on Public Health of Finsbury*, 1906, pp. 47-56.

It seems therefore impossible to resist the conclusion that in spite of the tendency of nature on behalf of the new born child, poor physique and ill-nutrition of the mother exerts an injurious effect upon the infant.*

The second group of deaths, namely, those due to epidemic diarrhœa, are obviously due to some disturbance of the alimentary system owing to wrong feeding. They die mostly in the summer months, mostly in towns, and the vast majority have been artificially fed. We have found in Finsbury that of the mothers of healthy children eighty per cent. at least breast-feed their infants. But of the mothers of dead infants only thirty-five per cent. and of the mothers of infants dead from diarrhœa only seventeen per cent. breast-fed their babies. This is the only difference between the living and the dead. All equally poor, equally well or badly housed, living the same kind of life, all under the same conditions except *this difference in feeding.*

The third group, lung disease, is due to exposure, particularly exposure to unequable temperatures. This exposure commences at birth when the infant exchanges a temperature of blood heat (98.5° F.) for one of room temperature (60° F.), namely a fall of thirty or forty degrees, and continues intermittently owing to carelessness in exposing children

* Though the matter cannot be considered in detail in such a book as the present, it should be added that part of the death roll due, directly or indirectly, to immaturity, may possibly be brought about by artificial interference with child-bearing. It has recently been stated, on medical authority, that this very pernicious practice is spreading in certain districts of England and is assuming serious proportions. If these things are so, it may account also for some of the infant deaths attributed to immaturity.

in many injurious ways. Bronchitis is most fatal to infants in the second month of life, and pneumonia in the later months of the first year. Mr. G. R. Sims has recently drawn public attention to the careless exposure of infants in public houses, where, if they do not even get gin they are very likely to get a chill. In a hundred other ways children of tender years are exposed to cold by ignorant mothers or nurses.

There, then, we have the three great causes of infant mortality.

1. The physique of the mother.
2. Unsatisfactory food.
3. Infant mismanagement and exposure to cold.

There can be no doubt about these being the roots of the evil. The issue is indisputable. Such and such diseases (or effects) are the definite result of such and such causes. Where these causes operate we get just these diseases and no other; where such diseases prevail there we get infant mortality. As the diseases guide us to the causes so the causes guide us to the means of prevention.

CHAPTER IX.

METHODS FOR THE PREVENTION OF INFANT MORTALITY.

"First concentrate on the mother. What the mother is the children are. The stream is no purer than the source. Let us glorify, dignify, purify motherhood by every means in our power. . . . In every aspect of this subject let us have good mothering; that is at the bottom of happy. healthy children."—THE RIGHT HON. JOHN BURNS, M.P. June 13th, 1906.

A COMPLEX problem, such as this, is no doubt brought about, as we have said, by an "ancestry of causes"; some of which have their origin far back in social or family life. Not one preventive method but many will therefore be necessary, if we are to wage effective warfare. Broadly, however, it may be said that the main lines of reform are to secure physical efficiency in the mother, an improvement in the nursing and management of infancy, and the better feeding of the child.

I.—Physical Efficiency of the Mother.

One of the supreme assets and bulwarks of a nation is its *motherhood.* Wherever we turn, and to

whatever issue, in this question of infant mortality, we are faced with one all pervading primary need —the need of a high standard of physical motherhood. The death of infants is not a problem of sanitation alone, or housing, or even of poverty as such, but it is mainly a question of motherhood. No doubt external conditions as those named are influencing maternity, but they are in the main affecting the mother rather than the child. They exert their influence upon the infant indirectly through the mother. The infant depends for its life not upon the state or the municipality, nor yet upon this or that system of *crèche* or artificial milk feeding, so much as upon the health, the intelligence, the devotion, and the maternal instinct of the mother. So that if we would solve this great national problem it would appear that we must first begin with the mother.

Now what are the forces and influences which result in a high standard of physical motherhood ? We at once think of heredity, of up-bringing, of training, and of physical health, which in turn lead us to think of good housing (and still more of good *homes*), pure and nourishing food, freedom from hard work during child-bearing, a temperate life, healthy habits, and a wholesome mind.

These are not things to be bought in the market. They are the fruits of a liberal and common-sense education, and spring most naturally from seed sown in childhood. Nevertheless, much may be done in certain directions even after the girl has become a woman or the woman a mother. Let us name two of these directions :—

(1). If possible, a woman should be relieved of hard work of any kind for some time before and after child-birth. The present Factory Act (S. 61),

requires that an occupier of a factory or workshop shall not "knowingly" employ a woman within four weeks after child-birth. But this is not sufficiently drastic, and does not affect all women workers, and does not affect any *before* child-birth.

(2.) A child-bearing woman should be supplied with sufficient and nourishing food. This is perhaps one of the primary duties of the father of the child, but where that natural supply is not forthcoming assistance should be rendered from other sources. In Germany there are the insurance maternity funds. In France there exists a Society of Nursing Mothers, established in 1876, and recognised by the Government, which has for its object the protection and feeding of mothers before and after child-birth. It works by means of "refuges," relief bureaux, and dispensaries, and from 1877 to 1904 had sheltered nearly 10,000 future mothers, and watched over 39,000 children. Somewhat similar work is being done by Dr. Meile, in Ghent, in his admirable preventive work of twelve different "services" of aid in the rearing of infants. Then there are Madame Coullett's restaurants in Paris for nursing mothers, where any mother suckling her infant may obtain two good meals daily, without charge and without any question whatever being asked. "They are mothers—they are hungry—that is enough." Then in East London there is the Sick Room Helps Society, which provides personal help in the homes of poor Jewish women at the time of child-birth. Elsewhere in England one or two experiments in feeding suckling mothers have been tried, but reorganisation is necessary of the charitable agencies in England which have this sort of work for their object.

II.—The Better Management of Infancy.

There are two main points to be considered under this heading, namely, birth registration and the proper management and care of infancy.

By the Births and Deaths Registration Act of 1874 (S. 1), it was enacted that, in case of every child born alive, it shall be the duty of the parents, or, in their default, the occupier of the house in which the child was born, to give to the district registrar, within forty-two days of the birth, information and the necessary particulars for registration. Where this information has not been furnished within the specified period, the registrar may, by notice in writing, require the necessary information within not less than seven days and not more than three months. In practice it has been found that about half to two-thirds of the total births in England and Wales are registered within the six weeks' limit of the Act. In Scotland, by an Act of 1854, the period allowed for registration is twenty-one days, that is, three weeks in place of six weeks. The French Code (Civil Art. 55) provides for registration within *three days* of birth.

When it is remembered that about one-third of the total deaths of infants take place in the first month of life, it will be evident that many births first come to the knowledge of the Sanitary Authority on the bills of mortality, which, of course, effectually precludes any preventive action whatever. The fact is that one of the most pressing legislative requirements in the whole range of public health law is a provision requiring the earlier registration of births. There should also be some system of registration of still-births. There is, at present, no record kept in England of children born dead.

In 1908 the Notification of Births Act 1907 comes into vogue. It is an adoptive Act only and requires notification of the birth to the medical officer of health within thirty-six hours of occurrence. Registration remains unaffected.

Then in the next place there is a great deal of lost ground to be made up as regards the management of infancy. "Nothing seems to be wanting," wrote the Medical Officer of Burnley in 1905, "but a department to teach the burgesses commonsense, and mothers how to feed a child till its teeth come and how to nurse it when it is poorly." It is to be feared that this candid remark is very near the truth of the matter. The enormous sacrifice of infant life every year to lung disease denotes harmful exposure of babies to unequable temperatures and to cold, yet, next to food, warmth is one of the main requirements of young children, and it is closely followed in importance by cleanliness. It is, after all, the elementary needs that a young child requires for its life, namely, food, warmth, fresh air, cleanliness, and sleep. Now to secure these things calls for carefulness, foresight and skill in infant management, and these are not birthright faculties, but require training and experience. We must therefore (*a*) educate young mothers in domestic hygiene, and (*b*) still more so the older girls in the elementary schools. (*c*) Leaflets of advice should be issued and (*d* Lady Sanitary Inspectors and Health Visitors appointed to give timely counsel.

Much benefit has been derived in the opinion of those well able to judge, in districts well-equipped in regard to Health Visitors. In the Longwood district of Huddersfield, in Finsbury, in Preston, in St. Pancras, and in many other places

infant life has been greatly improved as the result of appropriate health visitation. Personally I am satisfied that this one of the most useful methods of preventive work. Much more might be done at the very outset of infancy by the Midwives who are at work all over the country. Properly applied advice to the mother from this quarter should prove invaluable, for it comes at the most opportune time of all, and it is essentially of a practical nature. The midwives of a district should be the second line of defence against infant mortality after the mother, and the third line of defence should be Health Visitors. Very much may be done by Health Visitors in teaching young mothers. In Finsbury and in St. Pancras "Schools for Mothers" have been started and have proved of the greatest value.

It should not be forgotten that much of the underfeeding and physical unfitness of women, and some of the infant mismanagement are conditions due to poverty, and therefore, in an indirect sense, infant mortality is partly affected by unemployment or irresponsible fatherhood. Motherhood clearly comes first in this problem, but the duty of fatherhood also has its place in any scheme of prevention.

III.—The Feeding of Infants.

Mothers' milk is by far the best food for infants. Such milk includes the best nourishment, is the most economical, and excludes the dangers and dirt of other foods. The consequence of this is that breast-fed infants thrive more than those fed in other ways. For instance, Dr. Robertson, the Medical Officer of Health of Birmingham, has shown that whilst the infant mortality of breast-fed

infants is only 7.8 per 1,000 births, that of infants receiving no breast milk is 252.3 per 1,000 births. Dr. Newsholme, of Brighton, has expressed this difference in another way. He has shown that the probability of death from epidemic diarrhœa is fifty-four times greater among infants fed on cows' milk than among those fed on breast milk, and one hundred and fifty-six times greater among infants fed on condensed milk.* Breast feeding is therefore the safest and best thing. If, however, owing to various circumstances that is impossible, then the next best thing is to feed infants on suitable modified cows' milk. It is to provide such milk that Infant Milk Depots have been established, and the best way to illustrate certain points as to infant feeding will be briefly to discuss the principle of these depots. They originated in France in 1892, and are now numerous in that and other countries. In the United Kingdom there are, or have been, about a dozen (Liverpool, St. Helen's, York, Leicester, etc., and in London, in Battersea, Finsbury, Lambeth and Woolwich). In 1893 a somewhat similar movement was started by the Hon. Nathan Straus in New York, which appears to have contributed to the reduction of infant mortality in that city.

The principles which should govern an infant milk depot may be stated as follows :—

(*a*) Absolute control of the milk and the avoidance of the serious fallacy of sterilising unclean milk. It is unsatisfactory to attempt to prepare a suitable milk for weakly infants from the general market supply, which has been shown not infrequently to be open to criticism, and such unclean milk cannot be made thoroughly wholesome

* *Annual Report Health of Brighton*, 1906, p. 18.

merely by sterilising it. Clean whole milk should be obtained, and the refrigeration, modification, and bottling, and, if necessary, pasteurisation (150° F. for twenty minutes), should, if possible, be carried out at the farm, on strictly sanitary and hygienic lines, and in this way home contamination of the milk is avoided. The suitable quantity of milk for "one feed" is placed in each bottle, from which the child is fed direct.

(*b*) Medical supervision of the entire management of the Depot and of the infants using the milk.

(*c*) A discriminating and careful distribution of the milk only to infants of the poor who cannot be breast fed; the object of the scheme being to feed only those children who really require it.

(*d*) The systematic study of the effect of the milk on the children; and

(*e*) The sale of the milk should be as far as practicable at ordinary market prices.

In the Finsbury depot which was established in 1904, on these lines, we adopted the three following standards of modification:—

A—One part separated milk, two parts water, + 8 ozs. cream + 7 oz. milk sugar to the gallon.

B—One part separated milk, one part water + 11 ozs. cream + 5 ozs. cane sugar to the gallon.

C—Two parts separated milk, one part water, + 12 ozs. cream + 5 ozs. cane sugar to the gallon.

This standard of modification yielded milk similar to human milk, and the three modifications are used as follows:—

Standard of Modification.	Age of Infant.	No. of Bottles per day.	Amount per bottle in ounces.	Amount per day in ounces.
A	Under 1 month old	9	2	18
	1—2 months old	9	3	27
	2—3 months old	8	4	32
B	3—6 months old	7	5	35
C	6—9 months old	6	6	36
	9—12 months old	6	7	42

Variations in quantity are made from time to time, and the modification is not applied in any hard and fast manner. The particular milk for each child, whatever its age, is carefully considered after the first medical examination. Generally, however, it may be said, that children receiving A modification consume from 6-10 ozs. of pure milk daily, those receiving B between 15 and 20 ozs., and those receiving C from 20-30 ozs. of pure milk daily. Periodical examinations of the milk have been made at intervals in order to check the process.

Each child is weighed and examined once a fortnight and a full record kept as to its progress. No medicine is given. Each infant is visited in its own home by the nurse.

The methods adopted have had for their object the feeding of infants of the poor who could not be breast fed (*a*) with properly modified milk, (*b*) in correct quantity, (*c*) supplied to provide regular feeding, and (*d*) bottled in such a way as to avoid every kind of home contamination of the food.

The results of the Finsbury depot have been exceptionally good,* and excellent results have

* The infant mortality in 1906, among the depot-fed infants was 65 compared with 157 per 1,000 births in Finsbury as a whole.

been obtained also at Liverpool and elsewhere. It is not suggested that infant milk depots are required everywhere, or that they are anything more than a palliative measure in lieu of the ideal of breast feeding. But there can be no two opinions as to their value if properly controlled. They are a species of milk dispensary, and they serve as schools of infant management. The rules and regulations alone are a good training to many of the mothers who attend such a depot. Their chief disadvantage is that they always seem to necessitate a charge on the rates for capital and maintenance expenses, and it is perhaps open to question how far it is wise or desirable to make heavy claims on the rates for the help and aid of a few persons only. On the other hand, it has to be remembered (1) that there is a very substantial saving in human life; (2) that quite apart from the actual lives saved, well fed infants are greatly improved in weight, physique and constitution; (3) that there is very much less illness and especially diarrhœa among such infants and certainly there is no evidence to suppose that scurvy is caused in a depot using fresh milk; (4) that a properly controlled depot serves as a school of infant management; and (5) that many other forms of public health expenditure involve a charge on the rates and are yet sanctioned by all reasonable men.*

* The question has naturally arisen whether it would not be possible to supply modified milk of this character to children requiring it through the ordinary channels of the dairy trade? The answer is that it is impracticable to adopt the principles we have discussed by a trade distribution. At the same time it should be added that the trade is quite able to provide various forms of modified milk of good quality, though at a somewhat prohibitive

Before closing this chapter on preventive methods for infant mortality it should be added that all true sanitary reform,—better housing, pure food, improved sanitation in the home and workshop, urban cleanliness, good water supply, and a high standard of personal hygiene—all these things are in the direct line of prevention, and must not be forgotten and neglected in seeking to stem the tide of death in infancy.

price for the very poor. And even were it obtainable the advantageous principles of the depot could not be applied. Recently I have had an opportunity of observing the good results following the feeding of a number of infants on what is known as modified "*Dried Milk.*" (Nathan's brand). This substance is the dried essence of whole milk, suitably modified, and when reconstituted forms a liquid milk, having much the same constituent parts as ordinary modified milk. It has, of course, the immense advantages that in powder form it does not go bad, can be kept sweet and good indefinitely, and is not affected by hot weather. There can be no doubt that it thus provides an excellent substitute for much of the milk upon which infants are fed. But even if it is used, the advantages of the depot system, as a school of infant management, are not obtained.

CHAPTER X.

THE HYGIENE OF CHILDHOOD.

"The main human problem is how to deal with the earth now—now that we have at length attained to conscious control—so as to cease perpetuating the lower forms and to encourage the production of the higher; by giving to all children born on the planet a fair chance of becoming, each in its own way, a noble specimen of developed humanity."—Sir Oliver Lodge, F.R.S., *The Substance of Faith* (1907), p. 17.

THE child is father of the man, and the children of to-day are the nation of to-morrow. If we would rear a race of strong men we must first breed healthy children. Yet the State has been slow to see that its children form its asset and guarantee for the future. There are, however, signs of awakening, and recent legislation has done much to protect childhood from evil outward circumstances. Factory legislation keeps them from too early or too excessive labour; the law gives them a free education; and various special Acts have been passed for their protection from cruelty and so forth. All this is in the right direction, and yet much remains to be done, particularly in the direction of hygiene.

During the last few years evidence has been forthcoming as to their ill-health. In a country without a compulsory military service, the school period of life affords the only opportunity of taking stock, so to speak, of the physical characters of the people. It is in this period that inquiries have recently been made which reveal the great need existing for much health reform. In Dundee 1,056 school children (aged five to fourteen years) have been medically examined with the result that fifty-seven per cent. were found to be diseased in one way or another.* In Edinburgh, Dr. Leslie MacKenzie, of the Local Government Board for Scotland, examined 600 representative school children, of whom seventy per cent. showed some form of disease. In 1903, Dr. Eichholz, giving evidence before the Interdepartmental Committee on Physical Deterioration said, " At Johanna Street Board School, Lambeth, which is the worst school by far of any I have seen, of the elder children, I consider ninety-two per cent. to be below normal physical condition, and of the infants as many as ninety-four per cent. The most grievous reflection of all is that there is practically no improvement in physisique as we go up the School."† Down in West Ham, Dr. Eichholz found eighty-seven per cent. of the infants and seventy per cent. of the elder children below normal standard, and in Manchester he found sixty-six per cent. below normal. In his report for 1905 Dr. Kerr gives the result of the physical examination of 18,686 children in the London Schools, and both boys and girls at each year of age from seven to fourteen are smaller and more stunted than children of the same age in

* Report of Dundee Social Union, 1905.

† Report, Vol. II. p. 22, par. 443.

Boston, Toronto, Chicago, and Lausanne! Here then we have the findings of science—findings which we cannot think of otherwise than as revealing a deplorable state of affairs. What suffering and misery and unfitness and inefficiency all this means! How can we expect good results either in the way of education or in the way of a strong and virile race if this be the condition of the children in our elementary schools? And alas! this is by no means the whole of the sad story as to child life. For to this tale of suffering and woe must be added 60,000 children who die annually between infancy and the infant school, a further 120,000 deaths of children every year under twelve months of age, and an untold because unregistered host of children born dead.

And so we lose every year 200,000 children under fifteen years of age, not counting those still-born. And this is in Britain in the midst of a Golden Age, and at the top of the civilisation of the world!

Such, then, is the problem we have to consider. In previous chapters we have dealt with the mortality of children under one year of age. Here we shall concern ourselves with children above that age, of the necessities of their life, of the diseases which spoil their present and mar their future days, and of the influences upon them of home and of school. Before dealing with these matters we may suitably consider some of the "milestones of development" as Dr. Hutchison calls them, in a healthy child."

Milestones of Development.

The life of a healthy child is marked by a series of steps in development. *Birth* should occur at or

* *Lectures on Diseases of Children* (1905), p. 17.

about the end of the ninth month of pregnancy, if it occur much earlier it constitutes prematurity. Not less than eighty per cent. of all children are what is called "well-born," that is, arrive in the world in a healthy state and properly equipped for a separate existence. Some, unhappily, are born with more or less serious physical disabilities, which greatly handicap them in life's race, and retard normal development. The *weight* of a child at birth is about seven pounds. At the fifth month it is fourteen pounds, in fifteen to eighteen months it is twenty-one, in six years it is forty-two, and in the fourteenth year it is eighty-four pounds or thereabouts. These weights being multiples (7, 14, 21, 42, 84), are easily remembered. The weight of an infant is about the most valuable criterion of health which we have. A wasting infant is rarely, if ever, a healthy infant. There is no sign of ill-health so reliable as abnormal weight. During the first year a child should increase in weight on the average about one pound a month, more in the early months, less in the later. Then about the third or fourth month a baby should hold up its head and begin to assume the *erect attitude*. This is one of the biological differences between man and the ape. *Teething* is a milestone of which everyone knows. The temporary teeth begin to appear about the sixth month, and continue appearing till the third year. The permanent teeth begin to come about the sixth year and, with the exception of the "wisdom tooth," have all arrived by the twelfth year. *Weaning* is the change of the child from suckling to artificial feeding. It should take place about the tenth or twelfth month. It is a mistake to wean too soon or too late. Infants which are breast-fed up to the tenth month are more healthy than bottle-fed infants. On the other hand, it is unwise for a mother to continue breast-feeding long after the twelfth month. Weaning should not take place, if it can be avoided, in the hot months of the summer. *The period of infancy* closes at the end of the first year, and at that

time the child should have some teeth, should be able to sit up by itself, and should be making the first trials at walking. It should weigh about eighteen pounds, and its head should measure about eighteen inches in circumference. An important milestone is the *closure of the anterior fontanelle*, which should take place between eighteen and twenty-four months. This is the opening under the skin between the side and front bones of the skull. If this soft spot on the top of the head is depressed, or does not close at about its normal period, it is a sign of ill-health. Lastly, the child should be making its first experiment in *talking* when about two years old. To these milestones must be added the remark that the healthy child grows naturally and in proportion. Absence of growth, rickets, curvature of spine, enlarged glands, and so on are, of course, signs of disease.

Causes of Physical Defects in Children.

It will be convenient in the consideration of this subject to attempt to find an answer to the question, What are the conditions and circumstances which have led to the terrible physical defects which exist? If it be granted that we are a civilised nation and that our people are kindly disposed to their own children, how has it come about that so many of these children are suffering from physical disability? Now it appears that the answer to this question is threefold.

First, *the conditions which cause still births and the death of infants in the first days and months of life operate injuriously on the survivors.* That broad fact must be clearly understood. Infant mortality is not a problem by itself, alone. It is a problem which guides us to other difficulties also, and it is not sufficient to suppose that its shadow covers infancy only. Most of the children passing

under the influences which kill 150 in each thousand are affected by those influences. They may not be actually killed but they are marked, some of them for life. We know that some of these influences are due to heredity in the true sense of the term, others are due to ante-natal conditions as we have seen in a former chapter, and others again arise out of the circumstances under which the child lives in its early days. We need not here enter into the niceties of differentiation as to what portion is hereditary, what due to ante-natal and what due to post-natal conditions. It will be sufficient to understand that some of the chief defects found in children are undoubtedly due to the same sort of influences which bring about infant mortality.

Let us name some of these defects. *Tuberculosis* is a disease which, in one form or another, affects many children. Indeed, about one-third of all the children who die in hospital die of this disease, which causes the death of upwards of 15,000 children under fifteen years annually. It mainly affects the lymphatic system, or bones, and Dr. Still has shown that it attains its maximum frequency in the second year of life. The most common channel of entry for the tubercle bacilli is by the lungs, but once in the body the disease has a much greater tendency to become wide-spread than in adult persons. All this may take place within the first year, and some of it is due to an inherited predisposition. Then there is *syphilis*, which kills not less than 1,500 children in England and Wales every year. This is an inherited but not a very fatal disease. It marks with physical defect many more than it kills. Another disease which begins very early is a

growth of the tonsil tissue at the back of the throat, producing a tumour-like mass, known as "adenoids." This is one of the chief causes of deafness in children, and of a certain amount of mental dulness. A fourth group of diseases which show themselves often from the day of birth, and carry off 25 per cent. of all children dying under five years of age, are various wasting conditions, immaturity, debility and so on. Now such conditions as these four are due in large measure to heredity, ante-natal and post-natal influences, and a nation which has many still births and a considerable infant mortality must not be surprised if it also has a high percentage of ill health among the children that survive and pass into its elementary schools.

Home Influence.

Secondly, *the influence of the home* is a factor of great importance. For children, education is, after all, more a thing of home than school, the business of which is largely to supplement beneficial home influences and counteract evil ones, and in the long run to effect real improvement in the home influence. The root difficulties of the problem of physique are personal habits, and these should be inculcated from the earliest days of a child's life, through the training and knowledge which it acquires at home. What are the necessities of a healthy life in a child? They are elementary, but they are essential. First and most important of all is sufficient and suitable food, then there is warm clothing, body cleanliness, fresh air, exercise, and a reasonable amount of sleep. A child obtains these things at home or not at all. Consider for a moment the kind of life a town child

lives to-day. For its food, starchy, sweet indigestibles, tea, bread and jam, given irregularly and gulped down hastily;* its under-clothing scanty and dirty; no bathing facilities, and as a frequent result a verminous body;† stuffy, overcrowded rooms; and disturbed and too little sleep. Up to four years of age a child requires twelve hours good sleep daily, which may be shortened to eleven up till seven years, and then to ten, and in its teens eight or nine hours. Late to bed and early to rise is unfortunately becoming the rule. And it is idle to expect to rear healthy children if the laws of hygiene be ruthlessly, continuously, or carelessly broken.

Home Feeding.—Particularly important is the question of food.

"*Food is at the base of all the evils of child degeneracy,*" says Dr. Eichholz, "that is to say, if we can take steps to ensure the proper adequate feeding of the children, the evil will rapidly cease. Other circumstances noted in connection with degeneracy are: bad clothing, bad boots, exposure, want of fresh air, over-crowding, filth, late hours, overstrain at work, and, to a less extent, the smoking by boys. But all these causes pale beside the stress laid upon food."‡ He attributed this underfeeding to (1) neglect, (2) parental ignorance, and (3) poverty.

In view of these facts it need not surprise us to learn that in 1905 in two London schools, in no way

* In 1905 in England and Wales 10,352 children under fifteen years of age died from diseases of the digestive system, *not* including epidemic diarrhœa.

† In 1905-06 out of seventy-four London Schools only, 11,000 children, including 6,000 girls and 3,000 infants, were sent to school verminous.

‡ Rep. Interdep. Com. on Phys. Deteriorat., 1904. Vol. ii.

exceptional, only forty per cent. of the children were well nourished. But from this evidence it will be seen that the problem is a home problem and one which can only be met by personal and domestic reform, as it has been met in New Zealand and Tasmania.

Particular Hygiene.—Nor is it only general hygiene that is lacking. "The organs of sense" in a child require careful watching, and it must be said that they have been somewhat neglected. Eyes, ears, nose, the organs of taste, and the teeth have been found by the medical inspection to which reference has been made to be in a sad way. The British Dental Association examined upwards of 10,500 children and found eighty-six per cent. with decayed teeth, in many cases decay had set in before the fourth year of life. Little wonder that 3,000 men were invalided home during the Boer war on account of defective teeth. Weak eyes and discharging or deaf ears are also extremely prevalent. Then, again, the simple complaints of childhood are sadly neglected in the home. Measles is an innocent affliction, but if it is badly nursed lung trouble may supervene at once or tuberculosis may follow subsequently. Elaborate nursing is not required, but it is essential that the child should be kept warm. In 1906, in Finsbury, there was an epidemic of measles among children, comparatively mild, but widespread. Some ten or twenty deaths might have been expected, but there were 115. Eighty-five per cent. of these deaths were due to the child catching a cold because it was badly nursed. Neglected colds and catarrh, lead, as we all know, to bronchitis and pneumonia. In 1905, in England and Wales, these two last named

diseases alone killed 24,000 children under five years of age, and measles captured another 10,000.

No doubt part of this mortality is due to ill-clothing and under-nourishment owing to poverty, but much, if not most of it is due to bad home nursing and to careless exposure. As an instance of one kind of exposure consider the following. Between the hours of nine and ten p.m. on Saturday, November 26th, 1904, a raw cold evening, with dense fog, when no child should have been out, I walked straight through the Borough of Finsbury (in Central London) and counted, in the half-deserted streets, 143 infants in arms. On Saturday, December 24th, 1904, between seven and ten p.m., forty-seven public houses were visited by a special counter, who found 903 men, 710 women, and 126 children inside them ; on Saturday, January 7th following, the same forty-seven public houses were inspected at the same hours, and 1,071 men, 724 women, and 137 children were counted in the bars. These two visits were paid at a time of " exceptional distress," and when large sums were being collected by the charitable for the relief of pressing poverty. Making all allowances for seasonal influence and so forth, these figures denote a custom—a custom which includes some alcohol-drinking by children—and one which cannot but exert an evil influence upon health and a retarding effect upon thrift. We must be quite frank. The fact is that though, as a rule, parents are well disposed to their children, generally, indeed affectionate and considerate in most ways, there is a good deal of neglect, indifference, and carelessness, associated with an appalling amount of ignorance in regard to child life. Miserable

home life is far and away the chief factor in bringing about their ill health.*

The Influence of School.

Thirdly *the influence of School* has not always been as helpful as it should be. Insufficient attention has been given to the suitable modification of the means of education to the physical requirements and capacities of each child. Not infrequently in the past there has been undue overcrowding of children in school, over-pressure, too much fine eye work in infants' departments, and a somewhat widespread neglect to attend to the physique of the child. Some of these evils are now being met by the care of the blind and deaf, the defective and epileptic children, and by the medical inspection and supervision of all children.

Insanitary Schools.—In addition to what may be termed the personal disadvantages of school life, such as premature schooling, or of exposure to all sorts of weather, or of mental strain, and so on, particularly on underfed children, there are the disadvantages of insanitary school buildings. There can be no doubt that the aggregation of large numbers of children in insanitary school rooms since 1870 is responsible for not a little of the physical unfitness which has occurred. And this has been due to two conditions, *structural insanitation* and *ill-ventilation*. In 1905 a report

* In 1905-6 the Society for the Prevention of Cruelty to Children received 38,705 complaints of neglect and ill-treatment of children. The Registrar General reports that in 1905 in England and Wales, 1,800 children under fifteen years of age were burnt to death by accidents, 1,759 under five years of age were suffocated, mostly by being "over-laid" in bed, and 120 more were murdered.

was furnished to the London County Council in regard to 438 elementary schools in the metropolis ; 64 of these were found suitable and requiring but few alterations to render them fit for the purposes of elementary education ; 261 were open to criticism and required considerable alterations to make them suitable ; and 113 or 25.8 per cent. of the total, were so highly insanitary and unsuitable that improvement was impossible and 92 of them had to be closed at once. The principal defects were "positively dangerous" staircases ; means of "ventilation and warming very bad or quite inadequate" ; or "the walls are bad, and all the stone work has perished beyond repair, the roofs are bad and the floors are very weak ;" again "the cloak rooms are bad, there are no lavatories, and the premises are very dilapidated" ; sanitary "offices" were repeatedly found to be wholly insanitary, with defective drainage, and a number of the schools were below the level of the street or "under the church," and many had not even an apology for a playground. Now it requires no elabolate argument to convince anyone that these conditions exert an effect on the children crowded together in such schools day after day, for seven or eight years. The plain fact is that up to the present, but little consideration has been given to personal hygiene or to school sanitation in elementary education in this country.*

Then there is a marked and general lack in ventilation. "The ventilation of practically all schools

* In 1906 only two out of forty-eight County Councils had any organised medical inspection of their schools, and in thirty-one counties containing nearly 8,000 schools and more than a million children there was no medical inspection of any kind at all. In 1908 medical inspection will be compulsory.

is defective," according to Dr. Kerr, the medical officer of the London Schools. "No natural methods are sufficient, and schoolrooms should be required to be ventilated so that the carbonic acid present should never exceed a total of ten volumes per 10,000. This is a condition perfectly capable of fulfilment, if required."† Some of the ill-ventilation is, undoubtedly, due to supineness or neglect on the part of the teachers, but much of it is due to absence of necessary appliances for effectual artificial ventilation. Whatever be the exact cause, Carnelly, Haldane, and Anderson have shown in the following returns how grossly the atmosphere of schools is sometimes polluted.

CARBONIC ACID IN 10,000 VOLUMES OF AIR.

Schools Examined.	Above 10 parts	Above 13 parts	Above 14 parts
42 naturally ventilated schools ..	38	31	29
26 mechanically ventilated schools	21	9	4

In the survey of the London Schools made in 1904 much ill-ventilation was found, but as is so often the case in England in such matters nothing much was done to remedy the evil. In 1905-6 the new medical inspectors for schools examined 648 departments in every kind of London elementary school, with the result that the ventilation in twenty-nine per cent. of them was open to criticism, and in eighteen per cent. was absolutely bad. Even the

† Interdepartmental Committee on Physical Deterioration, Vol. II. p. 42, par. 810.

lighting of these schools was deficient in forty-one per cent. and bad in twenty-six per cent.*

One further point must be mentioned. Many of these school children suffer from the added disadvantage of having to work as well as attend school. It has been estimated that there are 200,000 juvenile workers in this country employed in and for shops, in street trading, in home industries and in agriculture.† In America there are thus employed one and a half million children under fifteen years of age. Of course work in addition to school attendance soon plays havoc with the health and physique of children.

What is the Remedy?

First and foremost regular medical inspection. Every child should be submitted to medical inspection at least three times during its school life, and those requiring it should be kept under more frequent observation. The price of efficiency is eternal vigilance.

Secondly, somehow or other the children should be fed. It is useless to attempt education in an underfed child. In a system of compulsory education there is some responsibility resting on the State in this matter, but it is a responsibility which must be brought home to the parents ultimately. Merely giving children food at school does not solve the real problem. A better course probably is inquiry, by representative school relief committees, or other authorized persons,

* Report of Medical Officer for Education, London County Council, to March 31st, 1906 (1907).

† Report of Interdepartmental Committee on Employment of School Children, 1901.

into home conditions, and where necessary feeding out of voluntary or special funds and the strengthening of family resources.

Thirdly, parents should be punished for repeatedly sending children to school in a verminous condition.

Fourthly, if the sanitary condition of bakehouses and factories is important that of Schools is not less important. The means and maintenance of effectual ventilation and sanitation should be enforced.

Lastly, the elements of temperance and personal and domestic hygiene should be taught and practised in all elementary schools and training colleges.

CHAPTER XI.

THE CHARTER OF THE FACTORY WORKER.

"The regulation of factories by law rests on the broad principle that it is the right and duty of the State to restrict the freedom of individual action in the interests of the community. . . . The history of factory legislation presents a gradual scheme of protection for workers beginning with those least able to protect themselves and going on to others, at the same time increasing in stringency and particularity. It is also the history of a conflict waged between humanitarian impulses and commercial interests. The chief motive power which has pushed forward fresh measures and eventually secured their enactment has been sympathy with those to be protected."—ARTHUR SHADWELL, M.D., *Industrial Efficiency* (1906), vol. ii., pp. 1-4.

THE eighteenth century in England was a wonderful time. It was wonderful for many reasons, but not least in that of industrial revolution. To begin with, the population doubled and wealth advanced even more rapidly. On every side came new inventions and discoveries. The thermometer, chronometer, and lightning conductor; the spinning-jenny and spinning-machine, the "mule" and power loom; new roads and Brindley's canals; iron smelting and coal

mining; and greatest of all, perhaps, the steam engine—these were among the new forces which changed the face of England, which enabled her to withstand and survive during the terrible years of her struggle with Napoleon and her loss of America, and began for her the mighty career which has made her the workshop of the world and the greatest manufacturing country of which human history has record. And all this progress was helped by the temper of the time, by the larger sympathy of man with man, by the idea of the nation not as the property of kings and rulers, but as a great living society, complex in its various relations, but with its parts inter-dependent upon each other—ideas which came partly from Burke and the Pitts, partly from the turn of events, and partly too from the religious revival and the new philanthropy. And so it came to pass that men left the fields and the cultivation of the land to earn their living in the new factories and workshops, they left the south for the north, and the country for the towns, and England became a manufacturing nation in place of an agricultural one.

The Factory System.

No doubt the change led to wealth and made for Great Britain a place in the markets of the world. But if the increase of wealth was enormous its distribution was partial, and the means by which it was obtained left much to be desired. For these great changes brought with them their own evils, not the least of which were the hardships of an uncontrolled factory system. Men, women, and children laboured under the most appalling conditions of filth, overcrowding, insanitation and danger. The hours were excessively long, the

work often a heavy strain, and discipline and morality alike were wanting. It was such conditions which compelled Sir Robert Peel in 1802 to pass an Act for "the preservation of the health and morals of apprentices and others." As time passed, this was followed by other legislation which merely tinkered with the tremendous questions at issue, including an Act to fix the working age of children at nine years, and the working week for them at seventy-two hours. At last, in 1833, as a result of Lord Ashley's labours, came a Royal Commission to inquire into the hours of labour. This Commission, however, reported that any reduction would be a restriction which would so diminish production as to put the country at the mercy of foreign competition. Though little was done, an indirect result was an Act for the employment of children in factories on the part-time system, so that they might get some daily education. In 1861 came Lord Shaftesbury's Commission of Inquiry into the whole question of factory control and sanitation,* and from that originated a number of measures which were eventually consolidated in the Factory Act of 1878. This was amended in 1883, 1891, and 1895, and now all have been consolidated in the great Factory and Workshop Act of 1901, the charter of the rights and liberties of the English worker.†

The Factory Act.

There are two things which may be said at once respecting this statute. First, as the people were

* See also *Papers relating to the Sanitary State of the People of England*, 1858.

† See also *Industrial Efficiency*, by Arthur Shadwell, M.D. (Longmans and Co., 1906). vols. i. and ii.; and Oliver's *Dangerous Trades* (1902), pp. 24-62.

responsible in large measure for the making of it, so they are mainly responsible for its proper enforcement; and secondly, it is a statute which covers all factories and workshops of whatever kind, large or small, which to-day number not less than 100,000 factories and 150,000 workshops, giving employment to some five million work-people.* We must now therefore consider some of the requirements of this great measure, and for convenience they may be divided into four groups (*a*) the sanitary and safety clauses, (*b*) the home workers' clauses, (*c*) the hours of labour clauses, and (*d*) protection in special trades.†

(a).—Sanitary and Safety Clauses.

These sections of the Act deal with cleanliness, overcrowding, ventilation, sanitary conveniences, special provisions for bakehouses and laundries, and means of escape from fire. All factories and workshops must be kept clean and free from effluvia and other nuisance, and floors must be dry. Nor must these places be so overcrowded as to be dangerous or injurious to the health of the workers. The standard of 250 cubic feet of air space for each worker has been laid down; but this must be

* *Factories* include places where machinery not driven by hand is used in the process, and a few special trades whether power is used or not; *Workshops* are places where one or more persons are working for gain in making or adapting any article whatsoever. If the persons are all of one family and the place is within a private house, it is a *domestic workshop*. In factories the supervising authority is the Home Office, with few exceptions; in workshops, sanitation etc., comes under the local sanitary authority.

† The best book on this subject is *The Law relating to Factories and Workshops*. By Abraham and Davies. (Eyre and Spottiswoode), 1902.

increased to 400 during overtime of women workers, in workshops used as sleeping rooms, in bakehouses at night (9 p.m. to 6 a.m.) and in match factories where yellow phosphorus is used, and to 500 in underground bakehouses. The air space of each workroom and the number of persons who may occupy it must be stated on a notice affixed in the works, so that any one can see at a glance whether the place is overcrowded or not.

Another requirement is that "in every room in any factory or workshop sufficient means of ventilation shall be provided and sufficient ventilation shall be maintained." We have already seen how important is ventilation to good health. The Factory Act, it will be noticed, requires two things, "means" and "maintenance." The means are the various contrivances which should be provided by the employer for admitting fresh air and for allowing foul air to gain an exit. The maintenance on the other hand is largely left in the hands of the worker himself, who is often thinly clad, ill nourished, and tired, and therefore particularly susceptible to cold and to draughts. Hence it becomes necessary to control ventilation with reasonableness and common sense. In workshops where dust, gas, and other impurities may be inhaled, the matter is of even more importance than in the ordinary workshop. In such cases the factory inspector may require a ventilating fan or other mechanical contrivance. It is important to remember that a "reasonable temperature" is required by law for all factories and workshops (from 50°-70° F. according to the process).

Lastly, there is the matter of sanitary conveniences. "Every factory and workshop must be

provided with sufficient and suitable accommodation in the way of sanitary conveniences," regard being had to the number and sex of the workers. The words " sufficient " and " suitable " are of course of great importance. The former requirement is met, broadly, by the provision of one convenience to every twenty-five workers; the latter is a general term used in the attempt to ensure a good standard of propriety and decency, and it includes efficiency, proper separation from the workroom, and appropriate allocation to men and women workers. This requirement of the Factory Act is not a convenient one to discuss, yet it is nevertheless of the highest importance both for men and women, from various points of view, physiological, hygienic and moral. The public do not yet recognise how grave may be the physical results of a failure properly to exercise the natural physiological functions, results which are none the less grave because they may be delayed for months or years. A failure to rid the body promptly and regularly of excretal products may lead not only to habitual constipation but to diseased conditions of the blood, may predispose to constitutional disease, and may be the original cause of disease and misplacement of internal organs. There can be little doubt that much of the widespread anæmia and chlorosis, headache, lassitude and debility among factory women and girls arises from these causes. The vital importance of suitable and sufficient sanitary accommodation is therefore obvious. Yet in 1903-04, in a systematic survey of all the cotton mills in the north-west division of the country, the Factory Inspector found insufficient or unsuitable accommodation in Manchester in twenty-five per cent. of all the factories visited;

in Salford, twenty-nine per cent.; in Rochdale, forty-two per cent.; in Oldham, forty-seven; in Heywood, sixty-four; and in Walkden sixty-seven per cent.* In 1903, in South Wales, fourteen factories were found without any sanitary accommodation whatever.

The **safety clauses** for factories concern protection from machinery and the provision of means of escape in case of fire. All dangerous parts of machinery and gearing must be securely fenced or of such construction or in such position as to be safe to every person employed, and boilers must have proper safety valves. There are also restrictions as to self-acting machines and as to the work of cleaning machinery. Again, special means of escape in case of fire must be provided at the instigation of the Sanitary Authority in all factories and workshops in which more than forty persons are employed, in good condition and free from obstruction. Doors must not be locked or bolted while any worker is within the factory or workshop, and except in the case of sliding doors must open outwards.

(b) The Home Worker.

In certain trades it is the custom for employés to take home some of their work either for finishing or for undertaking the whole process. They thus become what is termed "out-workers" and their work is "home work." The control of this kind of occupation is of great importance, not only from the point of view of the worker in the prevention of some forms of "sweating," but also for the protection of the purchaser who might

* *Annual Reports Chief Inspector of Factories*, 1903, p. 103, and 1904, pp. 138-140.

otherwise be buying articles made under unhealthy conditions.

The requirements of the Factory Act aim at the prevention of home work being done (1) in dwellings which are injurious or dangerous to the health of the workers themselves, *e.g.*, through overcrowding, want of ventilation, or other insanitary conditions; (2) in premises where there is dangerous infectious disease. Lists of outworkers have to be sent twice a year by employers to the District Council.

(c).—Hours of Labour.

In the English textile factories there is a twelve-hours' day with two hours for meals; on Saturdays six hours, and half an hour; and work is not to continue more than four and a half hours at a stretch without a break of at least half an hour. Overtime, except under special circumstances, and Sunday and all night work is prohibited. The annual holidays are Christmas Day, Good Friday, and Bank Holidays. These limits work out at 55 to 56 hours per week, and about 2,860 hours per annum.

In the non-textile factories and workshops the same hours obtain, except on Saturday when the standard is eight hours, with one and a half hours for meals, stretch of work not to continue beyond five hours without a break. Overtime is allowed up to two hours on three days a week, and thirty days a year, with extra half hour for meal. The holidays are the same as in the textile factories.

In "women's workshops" other than domestic workshops and laundries, the same hours hold, except that there the five hours spell may be exceeded, and there is no overtime allowable. In domestic workshops women's hours, meal-times, holidays, and overtime are all entirely unregulated, and

depend upon pressure, need, and physical endurance. In laundries 60 hours is the weekly limit exclusive of meal times. Overtime is permitted three days a week or thirty in the year, without extra meal-time, and Sunday and all-night work is allowed.

Finally, there are certain processes, such as fish-curing, fruit-cleaning, etc., in which women are engaged, which are partly exempted from regulation for hours of employment.

Children from twelve to fourteen years of age may be employed for a portion of the day in factories and workshops, if they have reached the school standard for partial or complete exemption from attendance at school. Their hours of labour are strictly defined, and must never continue without interval for more than five hours.

Overtime and Employment after Child-birth.

There are two further matters that call for mention in this connection, the first concerns overtime and time cribbing, and the second employment before and after child birth. Overtime is a somewhat serious addition, particularly at certain times of the year, even though the cubic space per person must be increased (from 250 to 400) and though certain restrictions are made. Fifty-five hours a week are a heavy strain, especially on a woman ; in the winter they occupy the whole of the daylight. She leaves her home in the dark and returns to it in the dark. It is a species of banishment from home, and when overtime is added the strain is greatly increased. Nor can it be said that the legal hours are always adhered to. Ever since the new Factory Act came into force a large number of instances of " time-cribbing " have been reported. A factory

inspector in Manchester reported in 1902 that "the majority of firms always run from one and a half to two and a half minutes beyond legal times, and for this small amount it is almost impossible to take any action. Yet the habitual cribbing of only two minutes at each starting and stopping time represents a clear gain of a week per year."* At Oldham, in the same year, it is reported that "nearly all cotton mills crib time from two to ten minutes in each meal time."† Offenders readily pay the small fines imposed, which do not, of course, act as any deterrent, as even after paying the fine a good profit accrues from time cribbing. Laundry owners are also sometimes bad culprits.‡ In the three years following the new Act, 713 complaints of time-cribbing were actually received at the Home Office. They may be the exceptions but they are sufficient to indicate a practice none too rare.

Then there is the other matter, and it concerns more problems than one. Section 61 of the Factory Act, 1901, runs as follows: "An occupier of a factory or workshop shall not, knowingly, allow a woman or girl to be employed therein within four weeks after she has given birth to a child." Similar legislation exists in Belgium, Holland, Denmark, and Austria. In Germany the four weeks must be extended to six, unless a medical certificate is furnished approving of employment at the end of four weeks. In Spain the limit is three weeks but after the return to work the employer must allow one hour at least daily for nursing purposes without deduction of wages. In Switzerland a total absence from employment of women during eight weeks before and

* *Annual Report Chief Inspector of Factories*, 1902, p. 118.
† *Ibid.*, p. 119. ‡ *Ibid.*, 1904, p. 268.

after child birth is required, and on their return to work proof must be tendered of an absence since the birth of the child of at least six weeks. This is the most vigorous and enlightened standard in respect to this matter in Europe. The English standard is very difficult to enforce, the word "knowingly" acting as a defence which covers a multitude of errors. And, of course, it does not apply at all to home workers. Some women have to begin work again the same day as the birth of the child, and thousands work up to the last day before child-birth. There can be no doubt that this practice exerts a very detrimental effect on the welfare of the child, and is one of the direct causes of infant mortality.*

(d.)—Protection in Special Trades.

The Factory Act also contains provisions for the carrying on of particular trades, and a sketch of its operations, however fragmentary, would be incomplete without some reference to this matter. For convenience it will be sufficient to name Bakehouses, and Dangerous Processes as illustrations of this kind of control. In passing, a word may be said as to *Laundries*, which, though neither factories or workshops technically, are subject to all the ordinary sanitary requirements of the Act, to which reference has been made. But in "factory-laundries" special ventilating fans must be provided, and floors thoroughly well drained. Laundries belonging to institutions which come under other Acts, or which are charitable institutions or worked by persons of the same family, are exempt from the Factory Acts.

* See *Infant Mortality*, pp. 90-138, and *Rep. Interdep. Com. on Physical Deterioration*, 1904, Vol. I., pp. 116-129. (Miss A. M. Anderson). *Factory Rep.* 1906, pp. 233-236.

Bakehouses.

Bakehouses are divided into above-ground and under-ground. To both kinds certain provisions apply, and there are, in addition, other conditions governing those which are underground. The main requirements common to all bakehouses are (a) that every room used as a bakehouse shall be fit on sanitary grounds for that purpose; (b) that no sanitary convenience or ashpit shall communicate directly with the bakehouse; (c) that no drain shall have an opening within a bakehouse—gullies for waste water must therefore discharge outside; (d) the bakehouse shall be cleaned regularly, if white-washed, once in every six months; if painted or varnished the paint must be renewed once in seven years, and cleansed once every six months; (e) the place shall not be used as a sleeping place; and (f) no young persons under eighteen years of age shall do night work in a bakehouse. Then, in addition to these points, if the bakehouse be underground, *i.e.*, if the floor be more than three feet below the level of the street, there are further requirements, and the bakehouse must be certified by the local authority. These requirements may vary within certain limits, but the local authority has to be satisfied that the place is suitable "as regards construction, light, ventilation, and in all other respects." This general clause has been interpreted to mean that the height shall not be less than eight feet, and that the walls, floors and ceilings shall be properly constructed, and the room effectually lighted and ventilated. "All other respects" is a comprehensive term which covers many things, such as no animals being allowed, no overcrowding, separate storage of flour, receptacles for refuse and so on. Bread is probably an

unlikely channel of infection and most of the requirements of the Factory Act in respect to bakehouses have been made law for the benefit of the workers themselves. A similar sort of standard should be adopted in all places where food is prepared, and in all restaurant kitchens, and it is satisfactory to know that much is now being done for the protection of workers in such places.

Dangerous Trades.

The dangerous trades are those processes in which the worker is in danger of injury from the process itself.* Public opinion has rightly demanded that all should be done that can be done to prevent such diseases as lead-poisoning, anthrax, "phossy jaw," arsenic and mercury poisoning. Owing to more stringent precautions, including medical notification of all cases of these diseases, suitable washing accommodation, and prohibition of taking meals in the factory, the number of such cases is happily growing less, and the life of the worker is now considered of more value than the process. In 1899, for example, there were 1,258 cases of lead-poisoning reported, but in 1905 this had fallen to 592.† Regulations are now made by the Home Office for the following trades: white lead, earthenware, metal-smelting, file cutting, tinning and enamelling. These rules concern freedom from metallic dust, prevention of inhalation of poison, increased cleanliness, the use of leadless materials, and so on. Phossy jaw is now rare, as regulations are more enforced, and yellow phosphorus, which is the poisonous form, is less used in match-making.

* See Oliver's *Diseases of Occupation* (Methuen), 1907.

† *Annual Report Chief Inspector of Factories*, 1905, p. 345.

The same decline may be reported in metallic poisoning in water-gilders, silvering trades, potteries, and chemical works. Anthrax still claims some victims, and causes about ten deaths a year, infection commonly occurring in workers in wool, hides and horse-hair from Persia, Siberia or China. But here, too, there is improvement.

It is impossible to study the annual reports of the Chief Inspector of Factories* without being impressed by the splendid organisation now evolved on behalf of the factory worker. It is one of the most creditable and comprehensive pieces of work ever accomplished by the State in the interest and welfare of the individual.

* These valuable Reports are issued every year by Wyman and Sons, Fetter Lane, E.C. (Price usually 2s. 6d. and 4s.)

CHAPTER XII.

OVERCROWDING.

"The soul-destroying conditions of the one-roomed home."—(SIDNEY WEBB).

"In all plans for improvement in the condition of life the immense powers that can be wielded by the landlord for good need to be recognised, strengthened and brought actively to the front."—RIGHT HON. CHAS. BOOTH, *Life and Labour of the People in London.* Final vol., p. 210.

OVERCROWDING may be measured in various ways. It may be estimated, both absolutely and comparatively, by the number of houses to the acre; by the number of persons to the acre; by the number of families or persons to a house; by the number of persons per room; or by the number of persons per cubic space. Brief reference may be made to the chief of these ways of measurement.

1. Houses per acre. As a rule it may be said that primarily the value of land in towns determines the density of buildings on the land. Land in the City of London is not obtainable at a price which would yield a return on dwelling house property. It therefore becomes every year more

devoted to commercial buildings and offices only, and even these become more densely packed together. It was upon commerce that London built its prosperity and greatness, and so the commercial spirit has become more and more dominant and has played the chief part in creating the density of houses per acre in central London. Everything, including sanitation and the health and housing of the people, has been considered of secondary importance to the increase of commerce. So it comes about that in the city of London there are 14.9 houses per acre compared with 8.2 houses per acre in London as a whole. Bad as the sanitary effect was on the city, it became much worse on the districts immediately surrounding it.

In the Middle Ages London was contained within its walls. Round this medieval town there was no lack of space. Green fields came up to the boundary of the city, and many gardens supplied her markets with vegetables and fruit. One might walk through meadows from Holborn Bars to the hills of Highgate. Even a hundred years ago travellers leaving the City by its northern gates passed up the "City Road" or "Brick Lane" between open gardens and fields to the village of Islington. But with the enormous growth of London all the region surrounding it has been invaded and is now covered with bricks and mortar. This invasion was particularly disastrous to the districts lying just outside the city wall; commercial buildings were crowded in almost on top of the dwelling-houses. As a result though London has an average of eight houses per acre, Finsbury (the old Clerkenwell and St. Luke Districts) has nineteen, Shoreditch twenty-one

Bethnal Green nineteen, and Stepney eighteen. On the other hand Lewisham has three houses to the acre, Wandsworth four, and Hampstead five. It is evident that districts with high densities are likely to be less healthy than low density districts having abundant open space around the houses. In 1851, when the growth of Commercial London was increasing by leaps and bounds, Lewisham had two persons to the acre, Wandsworth four and Hampstead five. But the City of London had 128 and Finsbury 208. To-day the City has declined very much in persons per acre, because it is composed so largely of offices, but Finsbury still remains high at 180, in some districts rising to 245. Yet Sir Benjamin Ward Richardson's standard for a healthy city was 25.

2. Persons per Room. To obtain any clear view of the overcrowding of persons per house, it is convenient to take persons per room as an index ; for as a matter of fact, not half the population of London occupy whole houses. London lives in tenements and in flats. The private family house of the early part of last century has now become a " tenement house," a house let in lodgings. This transformation is, indeed, one of the most profound changes which has affected the housing of the people of London ; for, not only has it made an enormous difference in density of population per house, but it has materially altered the domestic habits of the people.

The census of 1901 showed that there were in London in that year 149,524 homes, consisting of one room only, and 201,431 homes consisting of two rooms. In the first set of homes there lived 304,874 persons, and in the second set 701,203 persons. This means that more than a million

people in London live in homes of two rooms or less. The report further went on to show that altogether 2,449,789 persons in the metropolis live in tenements of four rooms or less. That is the first broad fact to get hold of regarding overcrowding in London.

3. Persons per cubic space. The most accurate index as to overcrowding is, however, the number of persons per cubic space, for it is clear that to determine it merely by number of persons per room neglects the size of the room. The Bye-laws for space allowance require the very low standard of 400 cubic feet of free air space per adult for living and sleeping purposes, and 300 for sleeping only.* Half these amounts are necessary for children under ten years of age. This standard has not been used for London as a whole. We must therefore take a district, and to avoid possible sources of error we must determine the degree of overcrowding by actual enumeration at night time. In 1902 such a census was taken in a certain street in the central London District of Finsbury. The street is a typical one, consisting of sixty-three tenement houses. On December 20th, 1901, a midnight inspection was made of nine of these houses, containing sixty-four separate tenements or occupancies in which were found 158 adults and 114 children, or a total of 272 persons (*i.e.* 30 persons per house of seven to eight rooms). Judged by this cubic space standard forty-seven (or 73.4 per cent.) of these sixty-four tenements were overcrowded. In most of the cases the overcrowding was of a serious degree, as the following figures for some of the single rooms

* Huxley laid down an ideal minimum standard of 800 cubic feet for each person.

will show (one room is taken in each house as an example) :—

	No. of persons living and sleeping in one room only.			Actual cubic capacity in cub. ft. of the one room.	Cubic capacity required for the persons found in the room.
	Adults.	Children.	Total.		
A.	3	5	8	1,134	2,200
B.	5	3	8	770	2,600
C.	4	4	8	1,620	2,400
D.	3	4	7	770	2,000
E.	4	3	7	1,620	2,200
F.	2	3	5	770	1,400
G.	3	4	7	818	2,000
H.	4	1	5	1,511	1,800
J.	4	4	8	1,210	2,400

So much for the actual figures. But if one considers for a moment how very small is a room of 700 to 1,000 cubic feet capacity, and then of how in that one small room five, six, seven or even eight persons of both sexes live, eat, sleep and sometimes die, one begins to realise what overcrowding means. Moreover, the one room system, as Lord Shaftesbury said, is the one bed system.

Other night inspections were made in this street with the result that the owner was prosecuted and fined £26 6s. He then sold all his houses and left the district, considering himself a persecuted man. The results of the whole campaign in this street may be stated as follows :—

Date of Midnight Inspection.	No. of persons found.	No. of occupied tenements inspected.	No. of tenements overcrowded.	Percentage overcrowded.
Dec. 20, 1901 ..	272	64	47	73.4
Feb. 25, 1902 ..	471	129	78	59.6
Nov. 18, 1902 ..	324	87	38	43.6
June 24, 1903 ..	526	133	29	21.8
Aug. 17, 1904 ..	427	83	18	20.4

We see from a study of this one instance the appalling degree in which overcrowding may exist, and the effect of enforcement of the law in its reduction.

These figures for Finsbury are, we may hope, not the rule throughout the tenement dwellings of London. But the conditions revealed, are, alas none too rare, as has been proved in Liverpool, Birmingham and other cities. In Liverpool from 1901 to 1905 there were 6,239 convictions in the police courts for overcrowding tenement houses,* of which some 18,000 are registered. In the same city "about 9,160 people are at present housed in cellars." † And it is not only in the large towns, but in many a country cottage men, women and children are similarly overcrowded.

The Results of Overcrowding.

The effects of overcrowding must by this time be fairly well known. Small cubic space is bad and uninteresting in itself, but it also involves lack of ventilation and light, which bring in their train all manner of evils and various kinds of physical defects. In addition to this it must not be forgotten, that it entails an immense amount of physical and mental suffering that does not appear in death rates at all. Evidence was furnished before the Royal Commission on Housing, 1884, which went to show that upon the lowest average every worker living under overcrowded conditions lost twenty days in the year by sheer exhaustion and inability to work. We can, however, only accept such general evidence with reserve. Let us turn to some figures. They

* *Report on Health of Liverpool*, 1905, p. 76.

† *Ibid*, 1904, p. 70.

are cold, dry things at best, but they guide us more accurately than general impressions.

1. Length of days. In overcrowded communities life is shorter than under other conditions. Sir Shirley Murphy has compared the length of life in Hampstead with that in Southwark, a poor and overcrowded district, and he finds that comparing males in the two communities, out of 1,000 born in Southwark, 326 die before reaching 5 years of age, while in Hampstead, out of 1,000 born, only 189 die before reaching the age of 5 years. Again, out of 1,000 children aged 5 in Southwark, 40 die before reaching the age of 15, while in Hampstead the corresponding number is 24. At ages 25 to 45, when probably, so far as the community is concerned, the economic value of life is at a maximum, the differences in the two communities is most marked. Thus, of 1,000 males aged 25 living in Southwark, 236 die before reaching the age of 45 years, while the corresponding figure for Hampstead is only 125. Expressed in another way, Southwark males lose 13.0 per cent. of the period of infancy, 17.7 per cent. of the school age period, 28.0 per cent. of the working-period, and 59.1 per cent. of the period of decline.* It has been estimated that the "expectation of life" in Hampstead at birth is 50 years as compared with 36 years in Southwark.

2. Increased Mortality. A more convincing proof of the disastrous physical results of overcrowding appears when we examine the mortality statistics for various districts. For example, in Edgbaston, the suburb of Birmingham, the general death rate is 13.1, in the overcrowded Floodgate

* Eleventh Annual Report of Medical Officer of Health for London, 1903, pp. 19 and 20.

area in the middle of the city it is 31.5.* In Hampstead it is 9.4 as compared with Finsbury, the most overcrowded tenement district of London, where it is 21.5. In the least overcrowded census area of Finsbury, the death rate is 14.4; in the most overcrowded census area it is 31.4.†

But it may be said that poverty, alcoholism, vice and so forth, bring about these variations, something more exact in relation to overcrowding is necessary, if its effect alone is to be studied. Of course, overcrowding brings many of the other disabilities, and that is part of the way in which it operates. Some guidance, however, may be obtained by the two following returns: (*a*) Sir Shirley Murphy furnished a table to the Committee on Physical Deterioration,‡ which sets out mortality in relation to increase of overcrowding in London for 1901:—

Proportion of Total Population living in tenements of one or two rooms.	Death rate per 1,000 living.	
	From all causes.	From phthisis.
Districts with 0-12 per cent. overcrowding	13.4	1.1
12-15 ,, ,,	16.1	1.4
15-20 ,, ,,	17.7	1.6
20-25 ,, ,,	15.3	1.5
25-32 ,, ,,	18.9	1.9
32 and upwards ,,	19.7	2.0

(*b*) In Finsbury we have for four years past distributed the deaths of all persons and at all ages in relation to the number of rooms occupied, with the following somewhat remarkable results.§

* *Special Report by Medical Officer of Birmingham*, 1904.
† *Report on Public Health of Finsbury*, 1906, pp. 27-32.
‡ *Report*, Vol. III. p. 52.
§ *Report on Public Health of Finsbury*, 1906, p. 26.

FINSBURY, 1903 TO 1906. DEATH RATES PER 1,000 PERSONS FROM ALL AND CERTAIN CAUSES IN HOUSES OR TENEMENTS OF SEVERAL SIZES.

Size of tenements.	Census population, 1901, 101,463.*	ALL CAUSES.				PHTHISIS.			
		Death rate per 1000. 1903	Death rate per 1000. 1904	Death rate per 1000. 1905	Death rate per 1000. 1906	Death rate per 1000. 1903	Death rate per 1000. 1904	Death rate per 1000. 1905	Death rate per 1000. 1906
One-room tenement	14,516	38.9	40.6	32.7	39.0	4.5	4.5	3.5	3.4
Two-room tenement ..	31,482	22.6	21.9	19.5	22.5	2.8	2.2	2.1	2.3
Three-room tenement ..	21,280	11.7	14.7	12.3	14.8	1.2	2.3	1.3	1.4
Four-room tenement and upwards of four rooms	33,185	5.6	7.5	6.6	6.4	0.63	1.2	0.81	0.93
The Borough Death Rates	..	19.8	21.1	18.9	20.7	2.2	2.5	2.1	2.3

* For the purposes of this Table it has been necessary to use the Census Population (1901), for all four of the years included in the Table. It should not, however, be forgotten that the population is declining, and the Death Rates for each year in this Table are, therefore, approximate only.

The mortality returns for infectious diseases are precisely similar in purport.

Sir Shirley Murphy has shown that for 1891-1900 the infant mortality in districts of London with under 10 per cent. of overcrowding (more than two in a room), is 142 per 1,000 births, whereas in districts with a percentage of overcrowding over 35 it is 223 per 1,000 births. (See also p. 113.)

Now after making all allowances, a study of these two tables can leave no doubt in one's mind that overcrowding, especially in one and two room homes, is raising the death rate. A singular instance occurred in Finsbury in 1902 of the effect of overcrowding on mortality. There was a slum court of eleven houses, which had been condemned and was to be closed under the Housing Act. But unavoidable delay arose, and for three years the place remained occupied, though overcrowding increased, owing to displacement of persons from neighbouring houses as these were closed. In 1900 there were 140 persons living in this court, an increase on 1899 of some 30 or 40 persons; in 1902 there were 176, an increase of 36 on 1900. The conditions, poverty, bad living and so forth, were the same as before, the only difference was increased overcrowding. The death rate for the five years 1895 to 1899 was 46. From 1900 to 1902 it rose to 52.6. *In those three years fourteen children were born in the court, ten of whom died under one year of age.* Altogether there were twenty-four funerals from that one little alley in the three years, twenty of the deaths being due to lung disease and "debility"—diseases produced by overcrowding.

3. **Spread of Disease.** What has already been said as to mortality means, of course, that

overcrowding favours the spread of disease particularly phthisis, "debility" and infectious diseases. Sir Shirley Murphy has also shown for London that the phthisis death rate for districts with under 10 per cent. of overcrowding (more than two in a room) is 1.07, whereas in districts with over 35 per cent. of overcrowding it is 2.46 per 1,000 persons. The same sort of return could be drawn up for wasting and infectious diseases. It should be remembered that such a disease as phthisis brings poverty and all sorts of social evils in its train.

4. **Moral Evil of Overcrowding.** In 1866 Sir John Simon, Medical Officer of the Privy Council, wrote, "Where overcrowding exists in a sanitary sense, almost always it exists even more perniciously in certain moral senses. . . . To be subject to these influences is a degradation which must become deeper and deeper, for those on whom it continues to work. To children who are born under its curse it must often be a very baptism into infamy."*

It is unnecessary to burden these pages with appalling particulars of what Mr. Sidney Webb calls "the soul-destroying conditions of the one-roomed home"; it is sufficient to understand that decent life is impossible in one small room for a family of half a dozen persons of both sexes, with only one bed. And it is but a shade better in practice in the homes of two rooms. Yet a million people in London are now living in such homes.

Nor is immorality all. Lord Shaftesbury, speaking in Parliament in 1861 said, "When you ask why so many of the working men betake themselves to the ale house or gin palace, the answer lies

* Parliamentary Papers, 1866, Vol. xxxiii.

in the detestable state of their homes. I have had it from hundreds of both women and men that this cause, and this cause alone, has driven them to the use of ardent spirits. Nine-tenths of our poverty, misery and crime, are produced by habits of intoxication, and I trace these habits not altogether, but mainly to the pestilential and ruinous domiciliary condition of the great mass of the population of this metropolis, and the large towns of the country.*" Sir John Simon was of the same opinion.†

Causes and Practicable Remedies.

Finally, we must mention briefly what are the causes and what the chief practicable remedies of the overcrowding which exists. The latter depends upon a right understanding of the former. The Royal Commission of 1884 classified the "unquestioned causes" as follows:—

1. Poverty, the relation borne by wages to rent.
2. Demolition of houses inhabited by the working classes.
3. Relation between owners and tenants.
4. Remissness of local authorities in the administration of the law.

And the Commission might well have added a fifth—supineness or absence of public opinion—for they report: "Your Majesty's Commissioners are clearly of opinion that there has been failure in administration rather than in legislation, although the latter is no doubt capable of improvement. *What at the present time is specially required*

* Hansard, 1861, Vol. clxi., p. 1,070.

† See also *Temperance Problem and Social Reform.* Rowntree and Sherwell. (Seventh Edition, 1900), pp. 555 and 738.

is some motive power, and probably there can be no stronger motive power than public opinion."* Twenty years later precisely the same conclusion was arrived at by the Physical Deterioration Committee. "It would seem," that Committee reports, "that it is *not so much the instrument that is in fault as the impulse behind it.*" †

First and foremost then among all the practicable remedies for the housing problem should be placed an awakened civic conscience, and a well informed and active public opinion. Where this exists overcrowding disappears. It is said not to be practicable or too general or too theoretical. As a matter of fact it is the most immediate, the most practical, and the most imperative requirement of all. For with an enlightened and vigorous public opinion three things happen: (*a*) the local authorities at once administer the considerable powers they possess in this matter‡; (*b*) house farmers and slum landlords are made promptly to realise that property has its duties as well as its rights; and (*c*) the people themselves are educated as to the terrible character of the results of overcrowding, and themselves make increased effort to avoid it. It cannot be too clearly understood that sanitary reform in England waits on public opinion, and that without an "impulse" from the people no substantial housing reform is possible.

* *Rep. of Roy. Com. Housing of Working Classes*, Vol. I., p. 36.

† Report, Vol. I., p. 15-23.

‡ Local authorities can increase house inspection, enforce bye-laws, register house owners and vacant property, clear slums, provide dwelling-house accommodation, assist in the advancement of means of transit, and in many other ways bring about reform, if they wish to do so.

Secondly, there is improved transit, and in this way the town worker can become a dweller in the country. It is hardly over-stating the case to say that improved transit is the chief contributor to the solution of the housing question in the centre of our great cities at the present time. Much remains to be done in making the means of transit cheap, rapid and rightly directed.

Thirdly, there is a great sphere for the landlord and house owner to improve their relations with their tenants. Nobody else can exercise this influence so effectually or so easily, and it is because it has been so grossly neglected in the past that difficulties have arisen. If owners would look upon their tenants as valuable clients rather than as persons from whom the last farthing has to be extracted and the least given in return, the advantage to both parties would be considerable. Not a little of the gross overcrowding which has occurred in the past has been due to absolutely inequitable, careless or irresponsible management on the part of the owner.

Fourthly, the law controlling the housing question needs simplifying and making more coherent and intelligible, and especially does this apply to building legislation and to bye-laws. Finally, it requires much stricter enforcement.

CHAPTER XIII.

THE PHYSICAL EFFICIENCY OF THE PEOPLE.

"From improved and healthier homes would come to the people increased comfort and happiness, and more physical energy and greater strength to fulfil the duties of their lives, and to meet whatever demands the future may make upon them and upon our nation. The strength and even the existence of a nation depend upon the health of its masses. The stake at issue is a vital one to people and nation; and now more than ever is it necessary that the health and vigour of our race should be maintained at the highest possible attainable standard."—*The Sanitary Evolution of London* (1907), HENRY JEPHSON, late Chairman of Public Health Committee, London County Council.

"The people perish for lack of knowledge."—*Report of the Committee on Physical Deterioration* (1904), vol. i., p. 15.

WE now come, at last, to consider what are the general outstanding facts regarding the influences operating on the physical condition of the English people. Out of the immense complexity of such influences can it be said that there are any broad facts which will guide us as to the main sources of ill-health, of disease, and of

premature death? The answer is Yes, there are, at least, four such conditions, namely:—

1. An insanitary environment.
2. Poverty.
3. Alcoholism.
4. Lack of personal hygiene and responsibility.

In taking a wide view of the whole matter these are the "captains of the men of death" which emerge as the foes against whom war must be waged if we would "build Jerusalem in England's green and pleasant land."

I. Insanitary Environment.

The broad fact of the influence of the external environment upon the physical well-being of man is indisputable. If one of two twins of ideal parentage be placed immediately after birth under favourable external conditions and the other under unfavourable, we know that the former will survive and the latter will succumb. This experiment in abstract is daily made in practice in millions of human lives. So undoubted is the effect of insanitary surroundings that many authorities have claimed that it is the sole factor controlling the physical condition of a people. Though, as we shall see, that is not the case, unless indeed the individual counts for nothing, it is nevertheless true that it is the main operating factor.

What, then, it may be asked, are the chief elements in the formation of a healthy environment? The answer is two-fold. First, there are a set of circumstances which may be summarised under the broad term *sanitation*, and secondly, there is *home life*. Now, favourable sanitation includes the conditions which are essential if men, women,

and children are to live healthy and decent lives, and expressed in simplest terms they are as follows :

1. A well-built house, which is an adequate shelter from heat and cold, damp-proof, properly ventilated and lighted, and effectually drained.
2. No undue overcrowding of houses on the land or of persons in any one room or house.
3. An adequate water supply of good quality.
4. The prompt and effectual removal of refuse.

These four conditions furnish a sort of irreducible minimum of healthy environment, and it will be necessary briefly to refer to each point.

The Healthy House should stand on high ground upon a pervious soil, protected from north or east exposure. It should, if possible, have some open space around it, at least in front and at the back. "Back to back" houses are unhealthy, the sickness and mortality being at least one third greater than in "through" houses. Accommodation for animals should be detached and separate from the dwelling-house. The building should be of proper construction and contain damp-courses. Back yards or areas should be paved with hard, durable, smooth, and impervious paving. Curtilages should be gravelled, flagged, or asphalted, and suitably channelled and drained. Through ventilation is necessary (see pp. 58-68) and plenty of light. The drainage of the house should be in four systems, namely (*a*) Drainage of surface and subsoil by means of earthen-ware pipes and open joints, or channelling and opening outflow, with proper storm overflow ; (*b*) Rain water system of roof, guttering, hopper head, and rain water pipe discharging on surface or over gulley ; (*c*) Waste water system from baths, lavatories, and sinks, each trapped and branched into sink waste pipes, discharging over open gulley, trapped into the drain ; (*d*) Main drainage system of sanitary convenience

trapped into soil pipe, which passes down the house to the main drain, and thus to the sewer or cess pit. The best form of water closet is the "wash-down," the second best the "wash-out," In the country where water carriage is not available, dry earth systems are necessary, and with care can be made efficient and satisfactory. Supervision and regular scavenging are necessary.

It must be admitted that many houses both in town and country do not fulfil even the elementary conditions named. Much remains to be done all over England in the more effectual enforcement of the Public Health Acts, and the Housing of the Working Classes Act. What can be done to improve the housing conditions of the people has recently been demonstrated at Bournville by Mr. Cadbury; at Port Sunlight by Mr. Lever; at Earswick, near York by Mr. Rowntree; and at the Garden City at Letchworth, near Hitchin.*

Overcrowding has been already discussed in a separate chapter (pp. 163-176).

Water Supply.—Water is used for drinking, cleansing and trade purposes. The amount allowed per head per day, should be ten gallons for personal and domestic use, ten for municipal purposes, and ten for industries. Its pollution may unfortunately arise (*a*) from a contaminated gathering ground or source; (*b*) from surface filth in the vicinity of the source; (*c*) from sewage or drainage matter in its course; or (*d*) from unclean pipes or cisterns in the house of the consumer. It is in this way that water-borne disease is produced.

In this country, *diarrhœa and typhoid fever* are the commonest of such water-borne diseases. Since 1864, there have been more than fifty epidemics of water-borne typhoid fever, though they are now happily becoming rare. Such outbreaks commence

* See volume in this series on *Housing*, by Percy Alden, M.P., and E. E. Hayward, M.A.

suddenly, affect a large number of persons at or about the same time, and decline gradually. They have arisen from pollution of shallow wells (Guildford 1867, Hitchin 1883, etc.), or deep wells (Caterham 1879). Sources have more than once been contaminated (King's Lynn 1892 and 1897, Maidstone 1897). In these last named places, the water was polluted by typhoid excreta, and was ineffectually filtered. The same occurred at Lincoln in 1905. It is necessary to remember how important it is thoroughly to disinfect all discharges of a typhoid patient, including the urine, which is infective in about a quarter of the cases of this disease, most frequently towards the end of the attack and during convalescence, as it is by such discharges that infection is usually conveyed to water.

Good drinking water should be clear and bright, without marked colour or taste, without any turbidity or smell, entirely free from chemical impurities, and disease germs. Much depends upon the protection of the source or gathering ground of wells and water supplies; clean storage is also necessary, a dirty well or cistern being a source of danger; and lastly, domestic filtration may be necessary. There are at least two excellent home filters on the market, namely, the *Pasteur-Chamberland* (of porcelain), and the *Berkefeld* (of infusorial earth). Filtration at home can also be obtained by passing water through six or eight inches of clean sand, and three of gravel in a flower-pot. Charcoal filters are better avoided, as they readily become foul. There is only one safer thing to do with a doubtful water, and that is to *boil* it.

Refuse should be suitably stored in covered metal receptacles, and regularly removed. Cleanliness is most essential to health, for with dust and filth accummulation comes infection. Flies carry such infection to milk, dust carries germs, and filth of all kinds harbours the agents of disease.

The Tenement System. Closely connected with insanitary environment in many large cities, indeed, one of its chief direct causes, is as I have pointed out elsewhere, the tenement system of dwellings.* Mr. Jephson considers that three "failures" are mainly responsible for insanitary conditions still existing in London. First, he places the tenement system, secondly, the non-administration of existing law, and thirdly the absence of a central co-ordinating Health Authority for the metropolis.† The last two failures are being met in some measure, but the first is still one of the burdens of London. When London first began to grow it increased in population rather than in houses, and ever since, there has been some degree of what is called "house famine." Consequently, the private house has become a tenement in order to accommodate more people, which means that the house built to accommodate persons of one family has become a house let in lodgings for a number of families. The history of such a house is a dismal record of degeneration, and of "vested rights in filth and dirt." It is often overcrowded, ill-ventilated, with insufficient sanitary accommodation and facilities for washing and water supply. It affords daily opportunity for every kind of **domestic insanitation**, which is by far the worst form of insanitation. Then there is no pantry provision and no cooking range, for five out of every six families, and with only a small open grate decent cookery is impossible. Hence it comes about that both houses and tenants

* *Some Notes on the Housing Question in Finsbury* (1901), pp. 67-71.

† *Sanitary Evolution of London* (1907), pp. 428-432.

degenerate together. Not less than a million of the people of London live in such houses.

Can it be wondered at that **Home Life** is at a discount? Yet home life is the vital source of a nation. There is no single requirement of the health of a people so essential as simple, wholesome, homely homes. If we would create a healthy State or rear a strong and virile people, an Imperial race, the beginning and end, the first and last thing necessary, is a better home life. Those nations which possess this priceless asset will survive, those which lose it will fall. World-wide possessions and the world's market, a great navy and an ancient parliament are after all but the means of production of a true home life. Even these are not the foundations of a home which to be well built is established upon domesticity and family affection.

II. Poverty.

Mr. Seebohm Rowntree, in his investigations in York, divided families living in poverty into two, classes: (*a*), "families whose total earnings are insufficient to obtain the minimum necessaries for the maintenance of merely physical efficiency," and (*b*), "families whose total earnings would be sufficient for the maintenance of merely physical efficiency were it not that some portion of it is absorbed by other expenditure either useful or wasteful."* He found that in York 9.91 per cent. of the total population were in a state of "primary poverty," and 17.93 per cent were living in "secondary poverty." In the result 27.84 per cent. of the population of that city were living in

* *Poverty: A study in Town Life.* By B. S. Rowntree (first edition, 1901), p. 86.

such poverty that physical efficiency was not being, and could not be, maintained. Mr. Charles Booth has expressed the opinion that these figures are approximately correct for London and other large cities.* He found 30.7 per cent. of the total population of the metropolis living in poverty. We must, therefore, conclude that not less than a quarter of the town dwellers in England to-day are living in such poverty as directly affects their physical well-being. If this be so, it cannot be doubted that poverty is exerting an enormous influence on the physical condition of the people.

Results of Poverty. It has long been known that poor districts have: (1), a higher death rate; (2), a higher infant mortality; and (3) a lower physical standard than districts more favourably conditioned. But frequently this has been attributed to the external conditions of insanitation, naturally more marked in a poor district. A little thought, however, will make it evident that it is due in larger measure to what may be called internal conditions arising from poverty. There is, for instance, lack of food, not of the nature of a direct and rapid starvation, as in times of famine, but an insufficiency of food, especially among women and girls. If a child is insufficiently fed, he does not grow, but becomes stunted in body, and warped in mind; if a man has not enough to eat, he cannot work efficiently; and if a woman is underfed, she produces unfit offspring. Closely allied to this disability is unsuitability of food, which is improper, irregular and innutritious. There are thousands of factory girls within the 30 per cent. of the very poor,

* *Ibid*, p. 300.

who spend what they do spend on dress and amusement rather than on suitable food. Many girls of this class go without solid food until the middle of the day, and subsist at almost all times on tea, which as we have seen is not a food but a stimulant. Little wonder that the diet of the Edinburgh working man was found to be some 10 to 15 per cent. below minimum standard, and the York average 17 per cent. below standard of energy. Then there is overcrowding, due to inability to meet the rents demanded, and so to "save money" families live in one or two rooms only. Again, there is uncleanliness. Dust and dirt follow in the train of poverty. It is thus that food, such as milk becomes contaminated, houses retain tubercle infection, and tenements become filthy and the home of every kind of domestic insanitation. Then there is the question of clothing, scantiness or thinness of which causes many minor ailments., and lastly, there is the strain of continual effort, the incessant anxiety and wear and tear which accompanies poverty. Fatigue and insufficient rest are two conditions which exercise a most unfavourable influence upon health. Sir James Paget said that "in every day practice *fatigue* has a larger share in the promotion or permission of disease than any other simple casual condition you can name." In addition to the strain, there is for the poor in towns but little refreshing sleep, owing to overcrowding, verminous rooms or bedding, the proximity of public houses, or night traffic.

Mortality among the Poor. Though we cannot say that such and such diseases are exclusively the lot of the poor, there are nevertheless unmistakable indications that the poor

suffer from diseases more acutely than the rich. Not that poverty necessitates a low standard of constitution—for there are thousands of poor homes which, happily, make such a conclusion impossible—but that the conditions which follow in the train of poverty tend more frequently than otherwise to surround people with an unsatisfactory environment and habits from which they seem unable to escape, and which combined with lack of knowledge exerts an injurious influence on their physical life.

Take Finsbury for instance, a typical industrial community of 100,000 people in the middle of London, and consider these five facts :

1. Half of all the deaths occurring in Finsbury take place in institutions, such as hospitals, asylums, and poor-law infirmaries, and not in the homes of the persons dying. One in every four deaths occurs in a workhouse or infirmary, one in every five in a hospital.

2. The death rate for the whole of Finsbury in 1906 was 20.7 per 1,000, but among the very poor inhabiting the one-roomed tenements it was 39.0.

3. Consumption is three times more prevalent in Finsbury than in Hampstead, and 61.6 per cent. of the deaths from this disease in Finsbury in 1906 occurred in institutions, and not in the homes of the persons dying.

4. The death rates from all causes are highest in the areas which are poorest. The Borough has been sub-divided into seventy small areas, and the dozen or twenty high mortality areas are the poorest. They yield ten deaths per 1,000 more than the average, which itself is the highest in London.

5. Persons employed in casual labour, and in the lowest grades of industry, suffer from a higher death rate than those better placed. It is impracticable, without a census industry, to measure

this exactly, but we can take an instance in a particular disease. For example, consumption, the chief cause of premature adult mortality, has for the past five years been the cause of 10 per cent. of all the deaths which have occurred in Finsbury, but of 50.2 per cent. of the poorest class of casual worker.*

A consideration of such facts as these can leave us in no doubt as to the direct operation of poverty in producing physical inefficiency and eventually disease and death.

III. Alcoholism.

"In alcoholism," writes Dr. Newsholme, "we have to deal with a chief cause of national inefficiency." In the first place, it is a chief cause of poverty, the most prodigal of all wasteful expenditure; and in the second place, it is disastrous in its results. The President of the Local Government Board has declared that from 25 to 51 per cent. of total poverty is due to intemperance,† and Dr. Ralph Crowley states that of the causes of pauperism "it seems almost certain that drink would claim a proportion of one third to one half."‡ Mr. Charles Booth considers it is "the most prolific of all the causes" of pauperism. Nor need we be surprised at these appalling figures when we reflect that every working class family in this country spends an an average *six shillings per week* on alcoholic drinks, and that in the total the nation spends 160 to 170 millions every year in this way, which is many times as much as on education, more than the annual value of all dwelling-houses

* *Report on Public Health of Finsbury*, 1906. pp. 27-32 and 265-274.

† *Labour and Drink* (1904). By John Burns, M.P.

‡ *The Drink Problem* (1907). p. 203.

and business premises in the United Kingdom, more than on both the army and the navy, more, indeed, than would suffice to enable everybody to live and work rent free, and as much as all the rates and taxes added together.*

So much for the loss. But when we turn to its gains, its results, what the nation gets in return for this outlay, we are faced with a series of facts not less appalling. Twenty per cent. of the insanity has been directly or indirectly traced to alcoholism, and 60 per cent. of the indictable crimes of violence. "If sifted," states the Lord Chief Justice of England, "nine-tenths of the crime of England and Wales could be traced to drink." And then there is disease and death. In 1905 the deaths of 2,211 persons in England and Wales were certified as directly due to alcoholism. But to this figure must be added 4,008 deaths due to cirrhosis of the liver (a condition brought about by alcoholic drinking), much of the occupational death-rate, especially that connected with the drink traffic itself, and many of the accidents and suicides.

These figures call for but little comment, and carry their own conviction. There are, however, three notes which may be added. The first is that, as in 1904 so in 1905, 91 per cent. of the total deaths from alcoholism occurred within the chief working period of life (25-65). That is to say that men and women at their best are being carried off in this way. Secondly, if comparison be made between 1875-79 and 1900-1904 (see *Rep. of Reg. Gen.*) it appears that the death rate

* *The Economic Aspect of the Drink Problem* (1902), Sir T. P. Whittaker, M.P. Lees and Raper Lecture, pp. 11 and 12.

per million from alcoholism pure and simple rose from 65 to 105 for men (an increase of 61 per cent.) and from 25 to 71 for women (an increase of 184 per cent). This change is so marked and so steady that, after making all allowances, it probably indicates an increasing amount of alcoholic disease and fatality, especially among women.*

Thirdly, it must be remembered that alcoholism *incapacitates even more than it kills*, and incapacitates more by systematic "moderate" drinking than by occasional drunkenness. In addition to insanity there are various nervous diseases which are certainly due to alcoholic excess, and to which must be added forms of alimentary and heart disease, and premature degeneracy of tissue. It also predisposes to tuberculosis.† Little wonder that the Committee on Physical Deterioration in 1904, declared that if the drink question were removed three-fourths of the difficulty with regard to poverty and deterioration would disappear with it.

IV. Lack of Personal Hygiene and Responsibility.

One of the most interesting of the findings of the Committee on Physical Deterioration in 1904 was that which showed that a greater proportionate improvement had taken place in the environment than in the individual. Compared with a generation back, our houses are better, there has been an increase in wages and a fall in the price of food and

* *Infant Mortality* (1906), pp. 203-211. See also the chapter on this subject by Mrs. Scharlieb, M.D., in *The Drink Problem*, pp. 161-188.

† *The Drink Problem*, chapter by Prof. Sims Woodhead, pp. 52-83.

clothing; water supply is improved, so is every kind of sanitation, so are the hospitals, workhouses, reformatories and industrial institutions, so also are the factories, workshops and schools. Then there are museums and art galleries, newspapers and railways, telegraphs and the postal system, and an enormous increase of the power given to the people by which they may govern themselves. In fact there has been a vast improvement and advance *in everything in which the State helps the individual.* And yet there is another side to all this. Swiftly falls the condemnation :—" Laziness, want of thrift, ignorance of household management (particularly of the choice and preparation of food), filth, indifference to parental obligations, and drunkenness largely infect adults of both sexes, and press with terrible severity upon the children." " The people perish for lack of knowledge."* Lunacy and crime increase; and in large classes of the community there is no desire for improvement in proportion to the opportunities which are available. In short, there has been an ebb-tide *in almost everything in which the individual helps and develops himself.* Sometimes when one thinks of these things in their proportion one thinks of the old story of a world-empire with heart disease, of men and women who sleep through a Golden Age, of pearls before swine. " England takes care of her things," said Khama, " but she throws away her people." If it be true, it is a terrible indictment.

The Personal Factor.

In a certain sense it is true. For though England is, of all countries, the most humane,

* Report, vol. i., p. 15.

and perhaps does most for the protection of human life, it cannot, I think, be doubted that we have come to a time when we must recognise quite clearly that improved environment is not the only thing necessary for rearing a healthy race of men. There is the personal factor, without which there is little or no adaptation to environment. Admitting that there has been an enormous improvement, it is still evident that most of our social problems remain, and that men, women and children suffer and perish needlessly. Why is it so? The answer is that, although the State may do very much and every year is doing more, it cannot do everything. Personal hygiene, eating and drinking, moderation and cleanliness in the ways and habits of life, the appropriate inter-relation of work, repose, and recreation for mind and body, the charge of infancy, the care of children—these are matters of individual concern and individual knowledge and training, for which the State as such can do little or nothing. Yet these counsels for personal self-government, enforced from age to age by the ever-growing common experience of mankind, *are of vital importance to the health of a community*, and must on no account be deemed superfluous because sanitary authorities have been established, and public health law is administered by boards of local government. It is idle to expect good results from such means, if personal hygiene and the duties and rights of the individual be ignored. If it be true that the Empire depends upon the homes of the people, it is also true that home life depends upon the well-being and health of individuals. For the individual is the unit of the home as the home is the unit of the State.

Nor, unfortunately, can we say that this is all. The marked and persistent decline in the birth-rate in town and country alike since 1881, which is "the result of deliberate intention on the part of parents," opens a wide and difficult problem.*

The evidence shows that the decline in the birth-rate has been greatest where it is most desired, and that it accompanies not extreme poverty, but social well-being, foresight and thrift. In other words, the unfit are being propagated more than the fit. "In Great Britain at this moment," writes Mr. Sidney Webb, "when half or perhaps two-thirds of all the married people are regulating their families, children are being freely born to the Irish Roman Catholics, and the Polish, Russian and German Jews on the one hand, and to the thriftless and irresponsible —largely the casual labourers and the other denizens of the one-roomed tenements of our great cities— on the other. This particular 25 per cent. of population, as Professor Karl Pearson keeps warning us, is producing 50 per cent. of our children. This can hardly result in anything but national deterioration." This problem, one of the most serious and intricate which England has to face, is mentioned here as a remarkable illustration of the influence of the personal factor, in the physical condition of a people.†

Health of the Individual. Speaking recently at the Working Men's College in London, Dr. William Osler, the Regius Professor of

* See *Physical Degeneracy or Race Suicide.* By Sidney Webb (*Times*, October 11th and 16th, 1906).

† This particular personal factor originates, of course, in complex conditions and circumstances not unconnected with environment, but it is distinct from external sanitation and so forth. Mr. Webb holds that the State should contrive to make it easier for the thrifty, foreseeing, prudent and self-controlled parents to undertake family responsibilities. He recommends "the systematic endowment of motherhood."

Medicine at Oxford, summed up his advice as to how to be healthy in the following health rules:

1. No alcohol.
2. Less tobacco.
3. Less tea and coffee.
4. Good, plain food.
5. Cleanliness.
6. Plenty of fresh air.
7. Plenty of hard work.

In other words, no excesses, less stimulants, plain food, fresh air and hard work. It is a wholesome programme. Elsewhere in this little book will be found some facts concerning some of these matters. Here it is only necessary to add three brief comments from a public health point of view. First, as to cleanliness, which though it may come next to godliness in ethics, stands first as a preventive of physical disease both in the individual and in the community. The new science of bacteriology has demonstrated nothing with more certainty than that dirt leads to disease. Uncleanliness is not only inelegant and distasteful, it is the most direct channel of infection, whether as polluted water, dirty milk, or unclean bodies. Secondly, the maintenance of a high standard of personal health is the best preventive of disease. The conditions which favour disease are the overwrought brain, the over-fed stomach, the overloaded liver, the over-strained heart, the unexercised unexpansive lung, and the under-nourished blood. Yet people will not recognise this and rely instead upon a multitude of artificial means or the uncertain protection of drugs or of the Fates. Every man's first contribution to the State to which he belongs is one healthy, efficient body, his own; and this identical contribution is his

own best protection, for if the soil be healthy and resistant the seeds of disease will not flourish. Thirdly, the public health depends on the right and prompt treatment of the *beginnings* of disease.

The Future. From a consideration of these facts then, it becomes evident that the most urgently needed public health reform of the present day is not so much one of environment as of personal life. Fifty years of improvement of environment are now behind us; the future calls for a corresponding reform of personal life. And Ignorance and Lack of Self Control are the two roots of the evil. For a man's foes are they of his own household, and these can only with certainty be overcome by still greater powers of inheritance, of personal habit, and of mental and moral character. Much requires to be done in England in the direction of educational work in public health. Especially important is the training of girls in domestic hygiene, food values, and infant management; the personal guidance and teaching by well-qualified health visitors in the homes of the people; the awakening of a well-informed public opinion as to the inestimable value to the State of physical well-being; and the creation of a "health conscience." Any influence, also, which tends to counteract thriftlessness, alcoholism, and immorality, is an influence in favour of health, and the same is to be said of all social and religious agencies and influences which tend to raise the moral tone of the community or the character of the individual. For this reason it must not be forgotten that workers of many different views and creeds are all contributing, or should be contributing, to the betterment of life and health in England.

APPENDIX.

PRECAUTIONS FOR CONSUMPTIVE PERSONS.

Consumption is, to a limited extent, an infectious disease. It is spread chiefly by inhaling the expectoration (spit) of patients which has been allowed to become dry and float about the room as dust, or by directly inhaling the spray which may be produced when a patient coughs.

Do not spit except into receptacles, the contents of which are to be destroyed before they become dry. If this simple precaution is taken, there is practically no danger of infection. The breath of consumptive persons is free from infection, except when coughing.

The following detailed rules will be found useful, both to the consumptive and to his friends :

1. Expectoration indoors should be received into small paper bags and *burnt* immediately ; or into a receptacle which is emptied down the drain daily, and then washed with boiling water.

2. Expectoration out of doors should be received into a suitable bottle, to be afterwards washed out with *boiling water.* If a paper handkerchief is used this must at once be placed in a waterproof bag, the contents subsequently burnt, and the bag washed daily.

3. Ordinary handkerchiefs, if ever used for expectoration, should be put *into boiling water before they have time to become dry ;* or into a solution of a disinfectant, as directed by the doctor.

4. *Wet* cleansing of rooms, particularly of bedrooms occupied by sick persons, should be substituted for " dusting " and " sweeping."

5. *Sunlight* and *fresh air* are the greatest enemies of infection. Every patient should sleep with his bedroom window open top and bottom, a screen being arranged, if necessary, to prevent direct draught.

6. The patient should, whenever practicable, occupy a separate bedroom. *Children should never sleep in the same bedroom* as the patient.

N.B.—The patient *himself* is the *greatest gainer* by the above precautions, as his recovery is retarded and frequently prevented by renewed infection derived from his own expectoration.

7. Persons in good health have little reason to fear the infection of consumption. Over-fatigue, *intemperance, bad air, dusty occupations, and dirty rooms favour consumption.*

(Leaflet as used at Brighton.

Dr. Newsholme, Medical Officer of Health).

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HEADLEY BROTHERS, PRINTERS, LONDON; AND ASHFORD, KENT.

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